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INDIANA UNIVERSITY STUDIES

No. 19 BLOOMINGTON, INDIANA JANUARY 16, 1914

[Contributions from the Zoological Laboratory of Indiana University. No. 133.]

New Fishes from Western Colombia, Ecuador, and Peru

BY CARL H EIGENMANN, ARTHUR HENN, AND CHARLES WILSON

The following species of new fishes were collected for the most part by Mr. Charles Wilson and Mr. Arthur Henn; one was purchased from Rosenberg and the remainder were collected by or under the direction of Mr. Manuel Gonzales.

Mr. Wilson collected during January, February, and March of 1913 in the lower Patia and its tributary, the Telembi, in the upper San Juan basin, and in the Atrato basin. His expenses were provided for by Mr. Carl G. Fisher and Mr. Hugh McK. Landon of Indianapolis. Mr. Henn collected during the entire year of 1913 in the upper and lower Patia basin, in the lower San Juan basin, and in Western Ecuador. His entire expenses were provided by Mr. Landon.

Full accounts of these two expeditions will appear in the general account of the fishes of the regions covered.

LANDONIA[1] Eigenmann and Henn, gen. nov.

A genus of Tetragonopterinæ characterized by its teeth. Allied to Astyanax. Maxillary with two very broad straight edged teeth, their cutting edge continuous and more than half the length of the maxillary; premaxillary teeth in two rows very closely pressed together, three teeth in the outer row, alternating with the four of the inner row, all these teeth incisor like, finely notched; the entire series of premaxillary teeth about as wide as the first of the maxillary teeth, mandible with five or six teeth on each side, the posterior three similar but narrower than those of the maxillary, the anterior two narrower and finely denticulated, the cutting edges of the teeth continuous; second suborbital long, leaving a narrow naked margin; lateral line complete, caudal naked; gill rakers 17+8, slender; half as long as eye, those of the upper arch similar to those of the lower.

[1]For Mr. Hugh McK. Landon, who has made the studies possible.

Landonia latidens Eigenmann and Henn, sp. nov.

Type, 56 mm., paratypes, 5409 a-b C. M., 13100 I. U. M., 14 specimens, largest 59 mm. Vinces, Ecuador. Arthur Henn.

5493 a-d C. M. 13101 I. U. M. 22, 28-52 mm. Colimes, Rio Daule, Ecuador. Arthur Henn.

Head 4; depth 3.3-4; D. 11; A. 31-32; scales 8 or 9-45 to 50-5 or 6; eye 2.5 in head, greater than interorbital.

Compressed, clupeoid, ventral regions rounded, predorsal area rounded with a median naked line; parietal fontanel longer and considerably wider than the frontal, skull smooth; lower jaw very oblique, its tip entering the profile; mouth small, maxillary shorter than eye; dermal border of opercle wide; teeth as in generic description.

Dorsal pointed, its origin in middle of length, reaching about half way to caudal, about equal to length of head; adipose well developed; caudal equilobed, the lobes about equal to length of head; anal falcate, its origin under end of dorsal; its lobe about equal to length of head less opercle; ventrals small, considerably in advance of the vertical from the origin of the dorsal, not reaching anal; pectorals narrow, reaching to or beyond origin of ventrals.

Scales regularly arranged; few or no radials; caudal naked; a few scales along the bases of the anterior anal rays; lateral line sagging in front of the dorsal. Male with a glandular pouch and thickenings on the caudal rays just below the middle ones and one to three hooks on each of the anterior anal rays.

A conspicuous black spot on the basal two-fifths of the middle caudal rays, upper caudal lobe margined with dark; tip of dorsal dusky; no humeral spot, a narrow silvery band.

PHENAGONIATES Eigenmann and Wilson, gen. nov.

Mouth minute, teeth in a single series in each jaw, tricuspid except in posterior part of maxillary where they are conical, gill-opening wide, much compressed; chest not trenchant; pectorals large, reaching to middle of ventrals; anal very long, its origin far in advance of the dorsal; dorsal a little behind middle of body. No adipose fin, lateral line incomplete.

Phenagoniates wilsoni Eigenmann, sp. nov.

5354 C. M. Type, 41 mm. Paratypes, 13030 I. U. M. 7, 21-38 mm. Manigru. Charles Wilson.

5355a C. M. Paratypes, 30 mm. Certegui. Charles Wilson.

5356a C. M., 13031 I. U. M. Paratypes, 30 & 37 mm. Truando. Charles Wilson.

Head 4.6; depth 3.33; D. 9; A 53-55. Scales 7-7+34-7 (9+35 in one), Eye 2.2 in the head.

Much compressed, dorsal profile highest at origin of dorsal, ventral profile deepest at origin of anal; preventral area rounded, without distinct median series of scales; occipital process about as broad as long; occipital fontanel much wider and twice as long as the parietal, cheeks narrow and

long, entirely covered by the second suborbital; the mouth very small, the maxillary not reaching to the eye; lower jaw with nine teeth on each side, premaxillary with six, maxillary with eight, the first four tricuspid, the last four conical. The first four forming a continuous series with those of the premaxillary the four conical ones on the distal, curved portion of the bone. Gill rakers about 5+8.

Scales thin, the margins obscure, a single row of scales along the base of the anal rays; a few scales along the base of the caudal lobes.

Origin of dorsal slightly behind the middle of body; height of dorsal equals length of head; caudal lobes about equal to the height of the dorsal; origin of anal about equidistant from the snout and origin of its last third; ventrals small, reaching the anal; pectorals equal to the head less snout, reaching to middle of ventrals.

Translucent, a median dusky band along middle of caudal peduncle, fading out forward and continued narrowly on middle caudal rays; scales of back faintly marked with chromatophores, which become restricted to the margin of the scales on the upper part of the back. Chin and maxillary black, sometimes a dark streak back from upper part of gill opening.

MICROBRYCON Eigenmann and Wilson, gen. nov.

Very similar to Gephyrocharax, the lateral line incomplete and the anal much shorter.

Microbrycon minutus Eigenmann and Wilson, sp. nov.

5422 C. M. Type, 24 mm, 13109 I. U. M. Paratype 24 mm. Truando. Wilson.

Head about 3.66; depth 3.5; D. 10; A. 18; scales about 32; eye equals interorbital, 2.5 in head.

Skull broad, the fontanels linear, expanding into a rhomboid at the last occiptal process; second suborbital narrow, covering the entire cheek; mouth large, oblique; maxillary two thirds as long as eye, with one tooth; premaxillar with four teeth in the outer series, five in the inner; lower jaw with about eleven teeth on the sides, most of which are minute, conical; four larger teeth in front, of which the first and third are the largest.

Origin of dorsal about one and a half times as far from the snout as from the caudal; its highest ray shorter, the caudal lobes longer than the head; adipose well developed; anal comparatively short, its origin but little in front of the vertical from the front of the dorsal; ventrals reaching or not quite reaching origin of anal, pectorals to posterior third of ventrals; anal emarginate, its last ray considerably produced.

Scales thin without apparent lines. Caudal and anal naked.

A black line along the sides; a large spot at base of caudal; a few chromatophores along base of anal; back with scattered chromatophores, without black median line.

CERATOBRANCHIA Eigenmann, gen. nov.

A Tetragonopterid in which the outer series of teeth of the premaxillary has become the dominant one.

Lateral line complete, caudal with scales on its basal third; adipose fin well developed, origin of dorsal near middle of body; second suborbital in contact with the preopercle below; premaxillary with two parallel series of teeth, four teeth in each series, outer series more prominent. Teeth of lower jaw graduate.

Obtusirostris Eigenmann, sp. nov.

13154 I. U. M. Type 65 mm. Chauchamago, Peru. Purchased from Rosenberg.

Head 4.66; depth 4.66; D. 10; A. 16; scales about 4-35-2; eye 3.33 in head, equals interorbital or opercle, longer than snout.

Elongate, dorsal and ventral profiles very little arched, profile well rounded, the mouth horizontal, terminal; occipital only about 1/9 in the distance to the dorsal; skull almost convex; no parietal fontanel; occipital fontanel narrow, about two thirds as long as eye; second suborbital considerably narrower than eye, leaving a naked area behind it; maxillary about .66 as long as eye, its first tooth forming a series with the outer series of premaxillary; premaxillary with an outer series of four teeth of about equal size, each with three graduate lateral cusps and a disproportionately large median cusp; three perfectly similar teeth along the upper half of the maxillary, the first one as large as the maxillary teeth, the last about one third as large. Teeth of the inner row of the premaxillary very similar to those of the outer but smaller and the median tooth asymmetric. Mandibulary ramus with nine graduated teeth, very smilar to those of the outer series of the premaxillary, the median cusp much larger.

Gill-rakers about 7-11, those near the angle three-pronged or with lateral horns.

Dorsal rounded, the longest ray equal to head less snout, adipose fin well developed; caudal lobes about equal to the length of the head; origin of anal and last dorsal ray equidistant from snout; last anal ray considerably in advance of the vertical from the adipose; origin of ventrals more than an orbital diameter in front of the dorsal, just reaching the anal; pectorals reaching ventrals.

Scales large, thin, with numerous nearly parallel striae, regularly imbricate, lateral line nearly straight; anal with a sheath formed of a single series of scales; basal portion of caudal scaled.

A large vertical humeral spot crossing the third and fourth scales of the lateral line; a dusky lateral band extending on middle caudal rays.

Easily distinguished by its mouth, teeth, gill-rakers and shape.

Bryconamericus cismontanus Eigenmann, sp. nov.

5459 C. M. Type, 60 mm. Villavicencio, Manuel Gonzales. Allied to *B iheringii* differing in the teeth, anal, etc.

Head 3.8; depth 3; D. 10; A. 16; scales 5-37-4; eye 3, equal to interorbital; depth of caudal peduncle 1.5 in its length, 2 in the head.

Compressed, head slender, snout blunt; predorsal area with a median series of of ten scales; occiptal process about one seventh of the distance between its base and the dorsal; bordered on the side by two scales;

interorbital slightly convex; frontal fontanel blunt in front, about half as long as the parietal; mouth slightly more inferior than in *B. iheringii;* maxillary slender, about .66 as long as the eye; width of third suborbital about .66 diameter of the eye; a naked angle below the suture between the second and third suborbitals.

Five or six teeth in the outer series of the premaxillary, the second and fifth of the right side and the second and fourth of the left side withdrawn to form an incipient middle line; four teeth in the inner series; maxillary with two broad teeth; mandible with seven similar graduate teeth, the first three much the larger.

Gill-rakers very slender, 7+10.

Scales thin, regularly imbricate, with about six striae; anal with a few scales along the base of the anterior rays; caudal naked; lateral line nearly straight; no axillary scale (?)

Origin of dorsal fin very little nearer snout than caudal; the penultimate ray more than half the length of the longest, which is about 4.5 in the length; caudal equals length of the head; origin of anal below last dorsal ray; ventrals reaching anal, pectorals reaching ventrals. A vertical humeral spot; middle caudal rays dusky.

5460 C. M. 13155 I. U. M.

Two smaller specimens 43 and 50 mm. from Rio Orquiza in the same drainage may belong to this species. The scales are 6-39 or 40-5; D. 10; A. 20. Maxillary with three teeth; denticles of teeth more pointed and arranged in a straight line, (the five denticles of the inner series of the premaxillary of the type in a curve); outer series of the premaxillary composed of two to four teeth. The second behind and to one side of the first one and opposite the space between the first and second tooth of the inner series.

Bryconamericus deuterodonoides Eigenmann, sp. nov.

5461 C. M. Type, 43 mm. 5462 a-q, C. M. 13156 I. U. M. Paratypes 13, largest 48 mm. Rio Negro, Quebrada at Villavicencio. Gonzales.

Allied to *B. hyphessus.* Dentition in both species very similar to that of Deuterdon.

Head 4.33; depth 3,66; D. usually 10, rarely 9; A. 17 or 18, scales 4 (rarely 50)-35 to 38-3 to ventrals; eye longer than snout, about equal to interorbital, about 3 in head.

Slender, compressed, dorsal and ventral profiles equally arched; preventral area rounded, without a distinct median series of scales; predorsal area rounded with a median series of 12 scales; occipital process a nearly equilateral process about one ninth the distance from its base to the dorsal, bordered on the sides by one or two scales; frontal fontanel triangular, not half as long as parietal; snout blunt, lower jaw included, maxillary-premaxillary border a regular curve; maxillary a little longer than premaxillary, about .75 of eye; cheek entirely covered by the suborbital which is somewhat pitted; maxillary usually with three, rarely with four, graduate 7-9 pointed teeth, occupying more than half the length of the margin; premaxillary usually with two, rarely with three narrow 3-5 pointed teeth, opposite the spaces between the first and second and second and third teeth of the inner series; four teeth similar to those of the maxillary but the

line joining their tips more arched and the largest point nearer the outer than the inner margin; each ramus of the lower jaw with seven to nine regularly graduate teeth; overlapping and slightly asymmetric on the side of the jaw.

Gill-rakers about 4+7, minute, the tip of one not reaching the base of the next.

Scales large, thin, with very few striae, regularly imbricate, without interpolated scales; caudal lobes with a few scales; a series of scales in part along the base of the anal in part on the sides; lateral line complete, decurved.

Origin of dorsal midway between tip of snout and caudal; highest dorsal ray about one sixth the length; adipose fin behind the vertical from the base of the last anal ray; caudal lobes equal to the head; origin of anal in front of vertical from last dorsal ray; ventrals very short, not reaching anal, their origin a little in advance of the origin of the dorsal; pectorals not reaching ventrals by two or more scales.

A faint vertical humeral spot crossing the fifth and sixth scales of the lateral line; a silvery lateral band, sometimes ending in a caudal spot extending in part on the caudal; fins all hyaline.

This species differs from Deuterodon in the complete armature of the cheeks, the presence of but four teeth in the inner series of the premaxillary. It differs in the nature of its outer premaxillary teeth from the typical Bryconamericus.

Bryconamericus henni Eigenmann, sp. nov.

Type, ♂ 48 mm. 5410 a-d C. M., 13102 I. U. M. Paratypes over 40, largest 53 mm. Vinces, Ecuador. Arthur Henn.

5411a-j C. M., 13124 I. U. M. Paratypes many, Colimes, Rio Daule, Ecuador, Arthur Henn.

Very similar to *Landonia laticeps*.

Allied to Argopleura in the presence of a glandular structure on the middle caudal rays; differing from it in the absence of prominent lower caudal fulcra; first ten and *last* ten developed rays of the anal of the male with hooks.

Head 4; depth 3-3.5; D. 10, A. 33; scales 8-38-5; eye 3 in head, slightly greater than interorbital.

Slender, compressed; ventral surfaces rounded, predorsal surface with a median series of scales; snout pointed, mouth terminal, or superior; skull rounded, parietal fontanel much longer and wider than the frontal; maxillary about .66 as long as eye, not nearly reaching suture between first and second suborbital; maxillary with a single, minute, hidden tooth, premaxillary with three teeth in the front series and four in the back series; mandible with five graduate teeth; a naked angle below the suture between the first and second suborbitals; gill rakers 12+11 all slender, the longest about half the length of the eye.

Origin of dorsal equidistant from base of middle caudal rays and middle of eye, the fin pointed, less than length of head in height; adipose fin well developed; caudal lobes equal, about equal to length of head. Anal falcate, the last ten rays in the male forming a second lobe; ventrals

reaching to or nearly to anal; pectorals at least to ventrals, sometimes to end of axillary scales.

Scales very regularly arranged; a row of scales along base of anal rays, caudal naked, lateral line scarcely decurved.

Dorsal tip dusky; a small sub-circular spot at base of the middle caudal rays; margin of upper caudal lobe dark; a submarginal dark band from the caudal spot along the upper margin of the lower caudal lobe; a narrow lateral band.

Middle caudal ray of male covered with a thickened membrane, the scales on the base of the lower middle rays enlarged, arching over a space beneath them.

Bryconamericus alpha Eigenmann, sp. nov.

5463a C. M. Type, 59 mm. 5464a-c C. M. 13157 I. U. M. Paratypes, 6, largest 64 mm. Villavicencio, Oriente, Colombia, Manuel Gonzales.

Allied to *B. caucanus* differing among other things in the shorter maxillary.

Head 4+; depth 3; D. 10; A. 23/4, 24/1, 26/3, 27/1; scales 6-40-4 or 5; Eye 2.66 in head, a little greater than interorbital.

Maxillary considerably less than the eye; mandible with four or five large teeth and smaller ones on the side; maxillary with 4/2, 3/4, 2/2 teeth where the denominator represents the number of specimens, the enumerator the number of teeth.

A vertical humeral spot, a lateral band continued as a dark band to the end of the middle caudal rays.

Bryconamericus beta Eigenmann, sp. nov.

5465a, C. M. Type 57 mm, 5466a-d C. M. 13158 I. U. M. Paratypes nine, largest 75 mm. Villavicencio, Manuel Gonzales.

Head 4-4.25; depth, 2.65-2.8; D. usually 10, rarely 9; A. 25/1, 26/1, 27/3, 28/4; scales 5 or 6-36/2, 37/4, 38/1, 39/1-3 or 4 to ventrals. Eye 2.8-3, equal or a little less than the interorbital; maxillary teeth 4/1, 3/2, 2/6.

Base of upper caudal lobe scaled for a fourth, that of the lower for a third of its length.

Ventrals to or not quite to the anal; pectorals about to ventrals; sometimes falling a little short or extending a little beyond origin of ventrals.

Color much faded, lateral band to end of the middle rays.

This may be synonymous with *alpha*. The present description may serve to call attention till better material comes to hand.

Bryconamericus scopiferus guaytaræ Eigenmann and Henn, sp. nov.

5474 C. M. Type, 76 mm, 13168 I. U. M., Paratype 83 mm. Patia at mouth of Rio Guaytara. March 13-14, 1913. Henn.

Five smaller specimens from the same place may belong to the same variety.

Head 4.25; depth 3 1/7; D. 11; A. 27; scales 6-38-39-6; eye 1 1/7–1 1/3 in interorbital 3-3.33 in the head. Depth of caudal peduncle equals its length.

Very similar to *simus* from the Chota valley which lacks the caudal spot.

Hemibrycon colombianus Eigenmann, sp. nov.

5470a C. M. Type, 106 mm, 13162 I. U. M., Paratype 106 mm. Rio San Gil, Santander, Colombia.

5471a C. M. 13163 I. U. M., Paratypes 2, larger 79 mm. Rio Piedras, Santander.

5472a C. M. 13164 I. U. M., Paratypes 2, larger 63 mm. Quebrada Deoca Monte, Santander.

5473a-e, C. M. 13165 I. U. M., Paratypes 10, largest 55 mm, Quebrada Mararari, Santander.

Head 4.33-4.5; depth 3.2 3.5; D. 10; A. 24 or 25; scales 8 or 9-47 to 53-7 or 8; eye equals snout, 3.5 in the head, 1.25-1.33 in interorbital; depth of caudal peduncle but little greater than its length, 1.66 in the length of the head.

Robust, not greatly compressed, ventral areas rounded, preventral area without a distinct median series of scales; predorsal area rounded with about 17 rows of scales, not in a median series; interorbital convex, about one-eighth in the distance between its base and the dorsal; parietal fontanel not quite twice as long as the frontal in the adult; second suborbital as wide as the eye, its margin very convex, in contact with the preopercle both below and behind; maxillary about as long as eye, not quite reaching the suture between the first and second suborbitals; maxillary-premaxillary border equal to snout and half the eye; four teeth in each row of the premaxillary, the outer series slightly curved; about seven heavy teeth occupying most of the edge of the maxillary, the anterior teeth tricuspid, the posterior triangular or conical; four large quinque cuspid teeth in the mandible, the middle point much the heavier and larger; abruptly small ones on the sides.

Scales small, regularly arranged, the series not deflected toward the anal; numerous nearly parallel radials; an anal sheath of several series of teeth; base of caudal with large scales; a well developed axillary scale; lateral line decurrent to the tenth scale, thence nearly straight.

Origin of the dorsal but little nearer the snout than the base of the caudal; its height a little less than the length of the head; adipose well developed; caudal lobes, including the scaled portion, about 3.5 in the head; anal low, its margin nearly straight, its origin under last dorsal ray, but little nearer opercle than caudal; ventrals small, not reaching anal by one to three scales; pectorals not reaching ventrals by one to three scales.

An obscure vertical humeral spot crossing the lateral line between the fourth to sixth scale; middle caudal rays dark.

Very largely described from the two largest specimens.

Piabira analis Eigenmann, sp. nov.

Mouth as in Creagrutus, anal long.

5478 Type, about 37 mm. Caceres. May 23, 1909. Haseman.

Resembling *Bryconamericus alburnus* but with a longer maxillary.

Head 4.3; depth 3.8; D. 10; A. 27; scales 5-40-3.5; eye 2.7; interorbital 2.5.

Compressed with less than half of the depth; preventral area rounded, with a median series of twelve scales; predorsal area rounded with a median series of fifteen scales.

Occipital process about 1/10 of the distance from its base to the dorsal, bordered by two scales on the sides; interorbital slightly convex; frontal fontanel a little shorter than the parietal; snout blunt, mouth small, the lower jaw included, maxillary two-thirds as long as eye; second suborbital covering the entire cheek; five teeth on one side, six on the other in the original front series, the second and third withdrawn, four teeth in the inner series; four teeth on one maxillary, five on the other; three or four large teeth in front on each mandible, several much smaller, similar and graduate teeth on the sides.

Scales as in *argenteus*.

Origin of dorsal a little nearer end of lateral line than the snout; origin of anal on the vertical from the *first* dorsal ray; ventrals reaching anal pectorals to second scale behind origin of ventrals.

Silvery, a very faint vertical humeral spot crossing the third and fourth scale of the lateral line.

Hyphessobrycon ecuadoriensis Eigenmann and Henn, sp. nov.

Type, 31 mm, 5417a-x C. M. 13105, paratypes, many hundreds.

Forest pool near Vinces, Ecuador. Arthur Henn.

Allied to *panamensis* from which specimens of equal size differ in the wider second suborbital, the broader predorsal area, the smaller eye, the shorter anal, the color, etc.

Head 3.5; depth 2.6-3; depth of caudal peduncle 7-8; D. 11; A. 22-24. Scales about 30 in a longitudinal series, about 11 in a cross series, but few scales with pores; Eye 3 in head, greater than interorbital.

Compressed, rather deep, caudal peduncle slender; predorsal area rounded, with a median series of about 11 scales; preventral area rounded, without distinct median series of scales; skull smooth, fontanels very large; second suborbital with a strongly convex margin, leaving but a narrow naked margin; mouth oblique, terminal, the maxillary short, but two-thirds the length of the eye. Premaxillary with 6 or 8 teeth, the lateral one conic the rest all tricuspid, a smaller tricuspid tooth in front of the space between the second and third of the inner series, occasionally between them and forming a continuous series with them. Maxillary with 0-3 minute teeth; mandible with 10 or more graduate teeth of which the anterior ones are tricuspid the rest conical. Gill rakers well developed on both arches.

Origin of dorsal a little behind the middle, its height 4 in the length, adipose well developed; height of anal lobe 4.5 in the length, caudal lobes 3; origin of anal under middle of dorsal, ventrals reaching anal or further, pectorals to or beyond origin of ventrals. Lateral line developed on five or six scales.

A conspicuous vertical black humeral spot, sides gray, no caudal line, no silvery lateral band or caudal spot, caudal and anal obscurely margined with dark.

Color in life brilliant; ventrals, anal and caudal bright cherry red. dorsal sometimes with less red; region above anal with many cherry chromatophores.

Astyanax hasemani Eigenmann, sp. nov.

5476 C. M. Type, about 55 mm, 5477a-e C. M. 13170 I. U. M. Paratypes, 9, 25-55 mm. Porto Alegre, Jan. 21, 1909. Haseman.

This species resembles *A. essequibensis* but differs in the more complete armature of the cheek, in the more decurved lateral line, etc. It forms a perfect bridge between *Astyanax* and some species of *Bryconamericus*. It always resembles the latter genus in the complete armature of the cheek; it usually resembles the former in having five teeth in the inner series of the premaxillary, but in two of the specimens there are but four teeth in this series. These specimens are typical members of the genus Bryconamericus in all but the arrangement of the teeth in the outer premaxillary series which are in a straight line, a condition which is also found in *Bryconamericus iheringi.*

Head 4.25; depth 3.25-3.33; D. 10; A. 21-24; scales 5-36 to 37-2.5; eye equals postorbital portion of head, 2.5 in head, interorbital 3 in head; depth of caudal peduncle 2 or a little less than 2 in the head.

Compressed, dorsal and ventral profiles equally arched; predorsal area narrow, with about 12 scales in a median row.

Occipital process about 1/8 of the distance between its base and the dorsal; interorbital more convex than in *essequibensis;* frontal fontanel narrow, triangular, shorter than the parietal; second suborbital leaving a very narrow naked margin behind, in contact with the premaxillary for its entire length below; maxillary long, narrow, maxillary-premaxillary border equal to the full length of the eye; premaxillary with an anterior series of three or four teeth in a straight row; four teeth in the second row in two specimens, five in the others, maxillary usually with four (rarely 3 or 5) minute teeth; mandible with four or five tricuspid, rarely quinquicuspid teeth and about ten abruptly minute conical or tricuspid ones on the side.

Scales everywhere regularly imbricate, no omitted or interpolated scales; scales with up to seven radials, usually not more than two; anal sheath composed of a single row of scales along the base of the anterior rays; a few scales on bases of caudal lobes; axillary scale well developed, lateral line deflected so that a line between its origin and end passes along the upper exposed angles of the series of scales above it.

Origin of dorsal slightly behind the middle; origin of ventrals but slightly in advance of the vertical from the dorsal; anal but slightly emarginate; pectorals never quite reaching ventrals, sometimes falling short of the width of two scales; ventrals not reaching anal.

Silvery, no distinct markings.

Astyanax metæ Eigenmann, sp. nov.

5457 C. M. Type 130 mm, 5458 C. M., 13153 I. U. M. Paratypes, 6, 103-130 mm. Rio Negro, Villavicencio. Manuel Gonzales.

Head 4+ ; depth about 2.5; D. 11; A. 29, 31, 25, 29, 28, 30, 30 in seven specimens. Scales 8-40-6; 9-40-6, 9-41-6, 8-40-6, 8-40-7 in five specimens. Eye 1 in snout, 3.5-3.7 in head, 1.3-1.5 in interorbital; depth of caudal peduncle 2 in head.

Compressed, rather heavy forward; preventral area rounded, with small scales and without distinct median series; predorsal area bluntly keeled, with a median series of 10 or 11 scales; occipital process extending about one-fourth of the distance to the dorsal, bordered by four scales on each side; skull convex, parietal fontanel about twice as long as the frontal; second suborbital convex, leaving a naked area of equal width about its entire border, except below the angle in front where the naked space is a little wider; premaxillary with four teeth in the outer series, four or five in the inner, when five the lateral one minute; maxillary with a single tooth; maxillary a trifle longer than the eye; each ramus of the mandible with four large teeth and a few similar minute ones on the side; gill-rakers slender, about a third as long as eye; 14 on the lower arch.

Origin of dorsal fully an orbital diameter nearer the snout than the caudal; highest ray of dorsal equal to the length of the head or a little shorter; adipose fin well developed; caudal lobes longer than the head; origin of anal under base of last dorsal ray; ventrals barely reaching anal, their origin slightly in advance of the vertical from the first dorsal ray; pectorals reaching at least to the origin of the ventrals.

Lateral line but slightly decurved; scales regularly imbricate except over the anal muscles and here the irregularity is slight; a sheath of a single row of scales along the anal; base of caudal similarly sheathed; a large axillary scale.

Faint traces of lines following the scales; no humeral spot; a large dark band extending from the tips of the middle ray and the three rays above the middle of the caudal to their base, expanding on the caudal peduncle and downward and forward, fading out above the origin of the anal.

Closely allied to *maximus*, differing from all other species in the oblique band on the tail.

Astyanax heterurus Eigenmann and Wilson, sp. nov.

5392 C. M. Type about 50 mm, 13085 I. U. M., Paratype about 46 mm. Turando. Charles Wilson.

Head 3.25; depth 3.25; eye 2.75 in the head, about equal to the interorbital.

Origin of dorsal equidistant from tip of snout and base of middle caudal rays; pectorals about equal to head without opercle, reaching past origin of ventrals; ventrals slightly beyond original of anal; anal falcate, its highest ray reaching to the last fourth or fifth of the base of the fin.

A vertically elongate humeral spot; a small round spot on the end of the caudal peduncle; color of caudal unique for the genus. Middle caudal

rays black to near their base, margins of the fin black, the lower marginal black, wider and more conspicuous and connected with the black of the middle caudal rays by a short black bar across the base of the lower lobe.

This species, evidently very closely related to *fasciatus*, is readily distinguished by the peculiar color of the caudal.

Curimatus patiæ Eigenmann, sp. nov.

5368 C. M. Type, 168 mm., 5369a-c C. M. and 13055 I. U. M. Paratypes 15, 96-160 mm. Barbacoas. Henn and Wilson.

Head 3.6-4; Depth 3-3.33; D. 11 (rarely 12); A. 9; scales 9-48-8 type, 8 or 9-44 to 48-7 or 8 (7 or 8-38 to 44-6 or 7 in *lineapunctatus*).

Very similar to *lineapunctatus*, a little more slender, the scales smaller, the lateral spots faint tending to run together to form longitudinal lines.

Parodon ecuadoriensis Eigenmann and Henn, sp. nov.

Local name, 'Roncador.'

Type, 49 mm, 5413a-c, C. M., 13103 I. U. M. Paratypes 17, 34-51 mm., River and forest pools, Vinces, Ecuador. Arthur Henn.

5423a-f C. M., 13110 I. U. M. Paratypes 28, 30-42 mm. Colimes, Rio Daule, Ecuador. Arthur Henn.

Head 4; depth usually 5.5, rarely 4.5. D. 12 A. 9; scales 4-37-3.5. Eye equals snout, 3.5 in head, less than interorbital.

Sub-cylindrical, elongate. Preventral area flattish, with a median series of about twenty scales; predorsal area rounded with a median series of 11 or 12 scales; skull smooth; no fontanels, the two frontals and the two parietals interlacing occipital crest decurrent, not superficially evident; second suborbital covering entire cheek; mouth small, distinctly inferior as in other members of the genus; four broad graduate, straight edged or rounded edged teeth in each premaxillary, each tooth with 11-16 notches; mandible without apparent teeth; maxillary with a single small dentate tooth. Gill rakers short slender, about fifteen in the lower arch.

Origin of dorsal in advance of the middle of the body, usually equidistant from tip of snout and end of adipose, its height about 4.5 in the length; adipose well developed; caudal lobes four in the length; anal six in the length; ventrals under posterior part of dorsal, not nearly reaching anal, pectorals not reaching ventrals by about four scales.

Lateral line straight, scales everywhere regularly arranged; scales of sides with as many as five more or less divergent radials;. Axillary scale well developed, caudal and anal naked.

A moniliform band from the eye along the lateral line and onto but usually not to the end of the middle caudal rays; area below the band white; a light stripe above the band; back dark, with the margins of the dark area and eight streaks from margin to margin darker; base of caudal with a dark spot or streak on each lobe.

Parodon terminalis Eigenmann and Henn, sp. nov.

Type 41 mm. 5415a-b C. M.; 13104 I. U. M. Paratypes, ten, 32-50 mm. Vinces, river and forest pools. Arthur Henn.

Very similar to *P. ecuadoriensis.*

Head 3.7; Depth usually 4.5, rarely 5; mouth terminal or subterminal very different from the distinctly inferior mouth with projecting snout of other species of this genus.

Lateral band continuous, sometimes not extending forward beyond the edge of the preopercle, not moniliform; back uniformly dark; spots at base of caudal lobes more diffuse than in *ecuadoriensis.* Otherwise as in *ecuadoriensis.*

Ecuadoriensis and *terminalis* are unquestionably very closely related. It is possible that the one is the river form and the other the forest pool form. The specimens from the two localities have not been kept distinct.

Nematobrycon amphiloxus Eigenmann and Wilson, sp. nov.

Nematobrycon palmeri Eigenmann (*non* Eigenmann 1907). Indiana University studies 18, 3, June (March) 1913.

Type 39 mm. Paratypes 12819 I. U. M. 26 and 14 mm. Boca de Raspadura, Eigenmann.

5353a-i C. M. 13027 I. U. M. Paratypes 54, largest 42 mm. Tambo. Charles Wilson.

5351a C. M., Paratype, Manigru. Chas. Wilson.

13028 I. U. M. Paratype, Istmina. Chas. Wilson.

5352a-e, 13029 I. U. M. Paratypes, 20, largest 44 mm., Raspadura, Charles Wilson.

Very similar to *palmeri,* more robust, dorsal lower, caudal filaments shorter, anal less falcate, dark band not bordered by a light line above.

Head 4 (3.66); depth 2.5 (2.66-2.75); D. 10; A. 32-36.

Scales 6 or 7-6+28-5; eye 2.5 in head, greater than interorbital.

Highest dorsal ray 3.5-4 in the length; outer and middle caudal rays about 3.5 in the length. Band of the sides broad, fading out toward the upper part of the sides in front, more abruptly lighter above the anal but without a distinct light line along its border.

Poecilia fria Eigenmann and Henn. sp. nov.

Type, female 28 mm; 5420a-x C. M. 13107 I. U. M. Paratypes, largest female 33 mm., largest male 19 mm. Pool $4\frac{1}{2}$-15 feet. Vinces, Ecuador. Arthur Henn.

Head 4-4.25; Depth 3.75-4; D. 8; A. 10; scales 3-29-4 to ventral. Eye a little longer than snout, a little more than half the interorbital, three or a little more than three in the length of the head; width of mouth about three in length of head; about twenty-four teeth in the outer series of each jaw; large pores around preopercular margin; distance of origin of dorsal from base of middle of caudal 1.75-2, in its distance from the snout in the female, 1.5-1.66 rarely 2 in the males. Height of dorsal a little more than half length of head; caudal rounded; depth of caudal peduncle in females 2.5 in its length; caudal rounded, origin of anal in females nearer base of middle caudal rays than snout, in males much nearer snout than caudal; modified anal of male about two in the length.

Variable number (as many as 22) vertical cross lines, most conspicuous between origin of ventrals and last dorsal rays; the one over second

anal ray (second line in front of dorsal) in the female usually plainest; males with the corresponding line also plainest. Very rarely a vertically elongate humeral spot in the male; dorsal of male with more or less well defined marginal and basal dark bands.

This species, differing in the number of scales, position of dorsal, size of the intromittent organ and color, is very closely allied, if not identical with *Poecilia festae* Boulenger from the hot springs, 35° Centigrade, S. Vincenta.

Microglanis variegatus Eigenmann and Henn, sp. nov.

Type, 45 mm. 13106 I. U. M. Paratypes 36-45 mm. Forest pool near Vinces. Arthur Henn.

Head 3.5; depth 5; D. 6; A. 10 or 11; width of head a little greater than its length; eye 3 in interocular, about 5½ in the head. Head covered with thin skin; frontal fontanel extending to posterior margin of eye; occipital fontanel minute; mouth terminal, the lower jaw slightly the longer; width of mouth about equal to half the greatest width of the head; premaxillary bands of teeth very narrow, without backward-projecting angles, the length of the bands about half the width of the mouth; maxillary barbels extending to tip or a little beyond tip of humeral spine; posterior mental barbel but little shorter than the maxillary barbel; the anterior mental barbel to or a little beyond the gill-opening; gill-membranes narrowly joined to the isthmus; occipital process articulating with the dorsal plate which it meets about half way; origin of dorsal nearly equidistant from snout and adipose, the spine strong, shorter than the rays, 3 in the head; adipose fin reaching caudal, its length not equal to its distance from the dorsal, its posterior margin free, its length about 5 in the length; caudal slightly emarginate, about 5 in the length, its fulcra prominent; base of anal about equal to base of adipose, its tip reaching caudal; ventrals not reaching anal, their origin on or behind the vertical from the last dorsal ray; pectoral spine stout, one-half to two-thirds as long as head, with about 8-13 strong hooks behind, less prominent spines in front; humeral spine reaching to near middle or last third of the pectoral spine.

Adult variegated; fins like the body, traces of a darker band through the dorsal; belly white. Young marbled or less finely variegated. A lighter area through basal half of caudal.

Hemicetopsis amphiloxus Eigenmann, sp. nov.

5332 C. M. Type 88 mm. Creek near San Lorenzo, Patia basin. Jan. 14, 1913. Henn and Wilson.

13040 I. U. M. Paratype, 97 mm. Rio San Juan at mouth of Rio Munguido. Henn.

13009 I. U. M. Paratype, 53 mm., Quibdo. Coll. Wilson.

Head 4.5-4.66; depth 4.33-5; D. 7; A. 30; V. 6 or 7.

Snout broader and more blunt than in *othonops*. Eye 2.5 in interorbital, 7 in head. Premaxillary with two irregular series of teeth, vomer with a single series; mandible with a single series on the sides, two or three near the symphysis; first dorsal ray not prolonged in a filament; inner ventral ray adnate for half of more of its length, the longest ray

reaching the anus; pectoral ray not prolonged. Distance between base of last anal ray and base of middle caudal ray equals depth of caudal peduncle; base of anal 2.5-3 in the length; origin of anal midway between eye or tip of snout and base of middle caudal rays; origin of ventrals equidistant from snout and fourth, fifth or second third of anal.

Profusely covered with chromatophores; dorsal dusky.

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INDIANA UNIVERSITY STUDIES

20. SOME RESULTS FROM STUDIES OF SOUTH AMERICAN FISHES. By Carl H. Eigenmann.

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INDIANA UNIVERSITY STUDIES

No. 20 BLOOMINGTON, INDIANA MARCH 15, 1914

Prefatory Note

The present study is a continuation of 'Indiana University Studies,' No. 16, 18, and 19. It presents results obtained from a study of extensive collections of fishes from South America. These collections belong in part to Harvard University, and were made by Louis Agassiz in Brazil; in part they were made by Dr. John Haseman, and belong to the Carnegie Museum of Pittsburgh. The more important of the results are based on various collections made in Colombia and Ecuador by Prof. Eigenmann, and under his direction with the co-operation of Mr. Hugh McK. Landon by Manuel Gonzales, Charles Wilson, and Arthur Henn.

Accepted for publication in the INDIANA UNIVERSITY STUDIES.

SAMUEL B. HARDING,

WILL D. HOWE,

ARTHUR L. FOLEY,

Committee.

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Editor's Note—Issued April 25, 1914.

(Contributions from the Zoological Laboratory of Indiana University, No. 135.)

Some Results from Studies of South American Fishes

By Carl H. Eigenmann,
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I. LINES AND METHODS OF EVOLUTION IN SOME CHARACID FISHES

In the first volume of the American Characidæ, a study in Convergent and Divergent Evolution,' which has just been completed, there are considered the Tetragonopterinæ, Rhoadsinæ, Iguanodectinæ, Stethaprioninæ, Stichanodontinæ, and the Glandulocaudinæ. All but the last of these fall within Günther's definition of the 'Tetragonopterina.' There are recognized in the volume just completed fifty-three genera, and two hundred and seventy-five species, of which thirty-three genera, and one hundred and seventy-one species were described during the preparation of the monograph, either by himself or by my students, chiefly Mrs. Marion Durbin Ellis.

The subfamily Tetragonopterinæ, which is at present the dominant group of tropical American fishes, was defined by Günther (Catalogue of Fishes, British Museum, V, 1864) to include Piabucina, Alestes, Brachyalestes, Chirodon, Chalceus, Brycon, Chalcinopsis, Chalcinus, Gasteropelecus, Piabuca, and Agoniates, besides the genera listed below. Eliminating these genera, which are now relegated to various separate subfamilies or which (Alestes and Brachyalestes) are geographically extra-limital, there remain of Günther's South American Tetragonopterina: Tetragonopterus, with thirty-two species; Scissor, with one species; Pseudochalceus, with one species; Bryconops, with two species; Creagrutus, with one species; making a total of five genera, with thirty-seven species.

Of the Iguanodectinæ which were included in Günther's Tetragonopterina he recorded two species belonging to the genus Piabuca.

He recorded four species of Corynopoma and placed them in his Erythrinina. They are the *Stevardia albipinnis* considered below in the discussion of the new subfamily, Glandulocaudinæ.

In the last general review of the groups under consideration, that of Günther, there were thus considered a grand total of seven genera and forty-three species, as compared with the fifty-three genera and two hundred and seventy-five species, known today.

A. The Tetragonopterinae

The Tetragonopterinæ are small Characid fishes with highly differentiated teeth in more than one row in the premaxillary, and in a single series in the dentary and sometimes in the maxillary. They are scaled. The origin of the dorsal is near the middle of the body. The breast is rounded, and the gill-membranes are not united. There is no predorsal spine. There is usually an adipose fin, sometimes not. The caudal is scaled or naked; the anal is scaled or naked; the lateral line is complete or not; the maxillary has no teeth, or may have one or two teeth or more teeth extending sometimes along the entire edge of the bone; the scales usually cycloid, may be ctenoid; the premaxillary teeth may be in two rows or in three; the anal may be very short (nine) or very long (over forty); the form may be compressed and very deep, the depth being equal to half the length or slender, subfusiform; the scales may be regularly imbricate (slender species), or there may be interpolated series causing the rows to deflect toward the anal (small-scaled, deep species). The cheeks may be nearly naked, or the second suborbital may be expanded and cover the entire cheek; the ventral area may be rounded and have a distinct median series of scales, or two series of scales of opposite sides may meet in the center, or the ventral area may be compressed, the edges of the lateral scales bent over the middle line or not; the caudal lobes may be equal, or one of them may be longer; the teeth in the lower jaw may be all alike, or abruptly minute on the sides.

They are found everywhere from the United States to Patagonia, and from sea level to about 11,500 feet above it.

The genera are distinguished from each other by the various combinations of the alternative characters mentioned above. It is quite certain that some of these characters have been developed independently several times, so that while it is easy to define the genera it is difficult to point out their inter-relationships. It is also quite certain that, since not all possible combinations have

been noticed, the characters were either not assorted by chance, or there was a distinct weeding out of certain possible combinations whenever they appeared. It is possible that some of these predicable combinations exist but have not yet been discovered.

The Tetragonopterinæ are now at their prime; they abound in individuals and species, and they live in the greatest possible varieties of environment to be found in tropical America. (What is true of the Tetragonopterinæ, is true, of course, of the Characidæ to which they belong, but it is not true of any other subfamily of the Characidæ.) These conditions make a study of the lines and methods of evolutions profitable, even if the causes for them are not at present obvious.

The one fact that forces itself most conspicuously upon the attention is that the same character present in different members of the Characins in general and in the Tetragonopterinæ in particular may have arisen independently several times.

The lateral line may become and has become incomplete repeatedly, and is undergoing that change now.

Three series of teeth have been derived from two, several times, and the process is going on now.

The caudal has possibly become scaled a number of times, and it may be that the condition is being produced now in certain species of Astyanax and Hyphessobrycon.

Teeth have developed along the entire maxillary a number of times, and the process is still in operation. The teeth have disappeared entirely from the maxillary a number of times, and it is safe to say that this end result is being approached in different series now.

Scales have become crenate, or ctenoid, more than once. A single series of teeth has given rise to two series, or of two series one has become lost several times, and the process is going on now.

The second tooth of the dentary has moved forward several times.

The predorsal line, fully scaled in many species, has become partly naked several times.

The second suborbital has expanded to touch the preopercle many times, and is making that change now in several instances.

The adiopose fin has disappeared in diverse types, and the process of its disappearance can also be seen at the present time.

The anal has increased or decreased in length in many different genera or species as a glance at the variation of the same species in different localities will show.

To go beyond the Tetragonopterinæ:

A pair of conical teeth has appeared behind the front series independently several times.

The pectorals have become enlarged and the pectoral muscles have become enlarged, and a greater or less trenchant ridge along the breast has developed independently several times.

This independent origin of characters is responsible for the fact that some of the accepted genera of the Tetragonopterinæ are of polyphyletic origin, i. e. our definitions of genera are in many cases enumerations of characters frequently independently acquired, not enumerations of the characters of the ancestral type of the genus from which the species have diverged. A result of this independent divergence is that frequently in a restricted, isolated area the species of different genera represented in the area are more nearly related to each other than to members of their own genera in remote regions. For instance *Astyanax festæ* and *Bryconamericus peruanus* of the Pacific slope of Ecuador are more intimately related than *festæ* is to *Astyanax anterior* of the upper Amazon. And in this case, *Astyanax brevirostris* or *Bryconamericus brevirostris* whichever it may be, is intermediate between the two. I am not competent to say whether *brevirostris* is moving from *Bryconamericus* to become an *Astyanax,* or whether it has just completed the reverse process. Certainly *festæ* and *brevirostris* are more intimately related, have had a common ancestor at a less remote time, than either of them with an *Astyanax* or *Bryconamericus* of southeastern Brazil.

We recognize two types of genera, one a group of closely related species, descended from a common ancestor and having certain distinguishing characters in common. Phenacogaster is such a genus. The peculiar scaling of the ventral surface has been developed but once; and the species are all closely allied, differing from each other in but a few characters. The other, a polyphyletic type, consists of species having a certain combination of definite characters in common which easily distinguish members of the genus, but which, instead of indicating a single ancestral line from which the species have diverged, are acquired possibly one at a time along distinct lines converging to a common definition.[1] Sometimes the polyphyletic origin can be detected, sometimes not. Bryconamericus seems to me to be such a genus;

[1]In traveling in the tropical forest, two plants that pleased the eye more than any others are the glorious, independent, self-sufficient palms, and the plumose bamboos; to me the most startling thing was the convergence of the two types to become climbers.

Hemibrycon, Deuterodon, and the larger genera are probably also polyphyletic.

Since it is difficult, or impossible, to say in any case which of the given characters has appeared first, it is extremely difficult to point out lines of evolution leading to different genera or species. We can only insist that certain innate possibilities may become actualities anywhere along the line, possibly wherever they may prove advantageous, though the advantage, to say the least, is not always obvious.

We may be permitted to assume that the more frequent character is the primitive one, although this is certainly not always a safe assumption.

In recent years it has been fashionable to assign causes for certain observed phenomena. This has led to the long-drawn out discussion of Lamarckism, Neo-lamarckism, Darwinism, Orthogenesis, etc. Without for the moment entering into the reasons, it may be worth while to give several instances of each of a few of the many changes that have evidently happened repeatedly, or are happening frequently now.

The common possessions of all members of the Tetragonopterinæ enumerated above, permit us to picture the ancestral type of the subfamily. In brief, it must have been a fish similar in most characters to *Astyanax fasciatus* Cuvier. This species, besides possessing all the characters common to all members of the subfamily, possesses also many of those positive (as contrasted with absent) characters enumerated for the family, and lacks some characters, like the highly specialized scaling of the ventral surface, ctenoid scales, extreme length of anal, extreme development of second suborbital, which are evidently highly specialized characters in a few of the genera. It is more widely distributed than any other species and has given rise to numerous variations.

It represents an average in length of head (4.3), depth, (2.6-3); length of anal (about 30); scales (about 38); size of eye (2.5-3); general shape (compressed subfusiform); position of dorsal (its base being in the space above the origins of the ventral and anal); size of mouth; and the characters of the teeth. The fossil fishes found at Taubaté—south of Rio de Janeiro—are similar to it in most characters. They are a little larger and may be members of the genus Brycon. In all but the teeth, they are very similar to *Astyanax fasciatus*. Their teeth have not been examined.

Without attempting to follow the lines of evolution from the *Astyanax fasciatus* type of the genera now dominant, we can

readily point out characters that have undoubtedly arisen independently in different genera. Very frequently the process is going on at present. In some rare cases, where a species is widely distributed, it may be in a state of stable equilibrium in one place, or over most of its territory; while at some definite locality it is changing, or, to make the statement conservative, it is unstable. See *Ctenobrycon hauxwellianus* below.

Assuming that the more frequent condition is the original one, there are enumerated below specific instances of a few of the cases where independently one character has changed to another.

The character that has been changed more frequently than any other is the lateral line. This has become incomplete repeatedly; and it is becoming incomplete in many instances at the present, unless we consider the instability itself a specific character of the species showing the change. Similar changes have taken place in other Characins of America and Africa and in Cyprinids.

Following is a table of genera with a complete lateral line and their relatives with an incomplete line:

Genera with lateral line complete.	*Genera with lateral line incomplete*
Tetragonopterus	none.
Entomolepis	none.
Moenkhausia	Hemigrammus (further changed into Pristella and Thayeria).
Astyanax	Hyphessobrycon (into Hasemania).
Knodus	none.
Markiana	none.
Gymnocorymbus	none.
Ctenobrycon	Psellogrammus.
Creatochanes	Brycochandus.
Bryconops	none.
Creagrutus	none.
Piabina	none.
Microgenys	none.
Bryconamericus	none.
Zygogaster	none.
Ceratobranchia	none.
Landonia	none.
Deuterodon	none.
Hemibrycon	Hollandichthys and Pseudochalceus.
Phenacogaster	Vesicatrus.
Scissor	none.
Henochilus	none.
Psalidodon	none.

Of particular interest are the following instances where the complete lateral line is giving rise to an incomplete lateral line:

1. **Ctenobrycon hauxwellianus Cope.** Of this species I was able to examine nearly 1,400 specimens from the Amazon between Montalegre and Tabatinga. In all of these, the lateral line is complete. I also examined 19 specimens collected by Haseman in the Lagoa de Parnagua, of the Paranahyba basin. In seven of these, the lateral line is complete, six are mutiliated, so it is not possible to say whether it is complete or not, and in six it stutters; that is, while it extends quite to the caudal, many scales along the line are without pores. A stuttering lateral line is the character of the genus Psellogrammus, from the Paraguay basin. While the species *Ctenobrycon hauxwellianus* is stable in the Amazon, and the process of being transformed into a distinct species of the genus Psellogrammus has been completed in the Paraguay, it is now indifferently a Ctenobrycon or a Psellogrammus in the Paranahyba basin. To make the statement general, a widely distributed species may undergo modifications in a restricted area while it is not changing over its general area.

2. **Phenacogaster,** which is one of the most highly specialized of the genera of Tetragonopterinæ, is found from Guiana to Bolivia, and in the Rio San Francisco. In all the specimens of the various species from Guiana to the Beni, except one, the lateral line is complete. In one specimen from the Beni, it is developed on but 26 of the 39 scales. In the closely allied form of the upper Paraguay basin it has been permanently reduced to but eight scales. It has been changed into the genus Vesicatrus. It is inconceivable that Vesicatrus should have been derived from any other source than Phenacogaster.

3. **Astyanax inconstans, daguae, Moenkhausia cotinho** and others are also mutating or inconstant. It is not only evident that the lateral line has changed in different genera, but it has changed and is changing several species of one genus into species of another genus. In *Moenkhausia cotinho* both forms with a complete and incomplete line are found throughout its known area of distribution. To make this statement general, a widely distributed species may offer material for the same evolution throughout its area of distribution.

It is not so clear in which direction evolution went, in regard to the scaling of the caudal. If we assume again that the majority indicate the primitive condition, the naked caudal is primitive,

and we have the following possibly independent lines of evolution to attain the scaled condition.

Caudal naked	*Caudal scaled.*
Hyphessobrycon	Hemigrammus.
Astyanax and Poecilurichthys	Moenkhausia-Tetragonopterus-Entomolepis-Gymonocorymbus-Thayeria and Pristella.
Bryconamericus	Knodus.

The change from a naked caudal to a scaled one seems to be at present taking place in *Astyanax tæniatus,* and in some of the smaller species of Hyphessobrycon.

None of the numerous other genera have crossed the line, and this character seems to be more firmly established since the group of genera centering in Moenkhausia have all evolved since the scaled caudal has developed. It is, in fact, quite possible that the differentiation into a group with a scaled caudal and another with a naked caudal is a primitive change; that the line has been crossed but once; and that Hemigrammus and Knodus with scaled caudals have converged in their other characters to Hyphessobrycon and Bryconamericus with naked caudals.

Teeth appear to have developed along the entire edge of the maxillary from a few along the upper corner, as follows:

With a few teeth	*With teeth along the entire margin*
Hemigrammus	Pristella.
Bryconamericus	Hemibrycon, Hollandichthys, and Pseudochalceus.
?	Phenacogaster and Vesicatrus.
Astyanax æneus	Astyanax nicaraguensis.

The change is now being made in *Astyanax nicaraguensis,* which has more than the usual number of teeth (as many as 11) found in its relatives.

Concerning several species of *Hemibrycon, decurrens, diquensis, boquiæ, tolimæ and colombianus,* it may be said that they are members of the genus Bryconamericus with extreme development of maxillary teeth, or members of the genus Hemibrycon with the minimum development of maxillary teeth. They are, in short, intermediate in character.

The method by which a single series of teeth has in a number of instances given rise to, or is giving rise to, a double series is illustrated by the genera:

Cœlurichthys		
Chalcinus		
Gasteropelecus	into	Thoracocharax.

In some species of these genera or some individuals of one species the teeth are crowded and some are moved forward out of line to form an anterior series on the premaxillary. In Cœlurichthys, the teeth are still in a single series in some specimens, and in a double series in others. In some species of Chalcinus, the teeth are in a single series, and in others they are in two.

In a few cases the double series of teeth has given rise to three series. By such a change Creatochanes has given rise to Bryconops and Bryconamericus has given rise to Creagrutus and Piabina. Half way conditions are found in a host of species where the front series of the premaxillary teeth are not in line, alternate teeth, roughly speaking, having been withdrawn from the front series to form an incipient middle series.

In some cases the number of rows of teeth is being diminished. In *Piabucus dentatus*, in fact, in the Piabucininæ in general, the anterior series of premaxillary teeth has been reduced to a single small tooth on each side. In *Piabucus melanostomus* of Paraguay, closely related to *dentatus* of the Amazon, even this small tooth of the anterior series has disappeared. In the Rhoadsinæ, the anterior series of teeth does not make its appearance until very late in life, and then the teeth are insignificant. In Ceratobranchia and Henochilus, it is the inner series of teeth that is disappearing, and in Psalidodon the inner series is gone.

Additional series of teeth appear by the crowding out of teeth from a single series, shall we say through an overplus of tooth-developing power. Series of teeth do not disappear by being absorbed into other series but by the dwindling of the teeth, shall we say by the diminution of the tooth-developing power.

An odd condition in the arrangement of the teeth in the lower jaw has apparently arisen independently in Moenkhausia, Stichonodon, and Fowlerina. In each of these genera some one, or more, species has the second tooth of the lower jaw moved forward out of line with the rest.

Finally, the adipose fin, one of the characteristic features of the Characins, has disappeared a number of times. By the loss of the adipose:

Hyphessobrycon	has given rise to Hasemania;
Piabucina	has given rise to Lebiasina;
Gasteropelecus	has given rise to Carnegiella;
?	has given rise to Stevardia;
?	has given rise to Nematobrycon.

Among a large number of specimens of Lebiasina, recently

collected by Mr. Henn, in Ecuador, a few are found which have the adipose, i. e., these few specimens are still Piabucinas, while their brothers and sisters are Libiasinas. It may be well to point out that Libiasina, until very recently, has been known only from the Pacific slope, Piabucina being its Atlantic slope counterpart. In northwestern Colombia the genera intercross.

I expect to deal more fully with these and other lines and methods of evolution in the final volume on the Characins, and hope that I can then go into the reasons as well as into the lines and methods.

B. The Rhoadsinæ

The Rhoadsinæ have been discovered but recently. At present there are two genera and three species known from Transandean Ecuador, Colombia, and Panama. They undergo a remarkable modification with age. The fully grown adults differ from some of the Tetragonopterinæ in having the sides of the lower jaw pressed inward somewhat, raised and provided with thorn-like teeth. The mouth in the adult is very large, there are teeth along the entire edge of the prolonged maxillary, and there is an anterior series consisting of one or two teeth on the premaxillary. In the young the mouth is minute, the maxillary short, just reaching the eye, with one or two teeth. In brief, the young of this subfamily have the characters of the genus Cheirodon, a genus of minute fishes. The subfamily characters become prominent only after the individuals have grown beyond the size of the members of the genus Cheirodon.

C. The Iguanodectinæ

The Iguanodectinæ consist of a few species only. They are found from the Essequibo to Paraguay.

They differ from the Tetragonopterinæ in having the gill-membranes united, free from the isthmus. They are elongate, slender fishes. The mouth is minute; the teeth are broad, multicuspid incisors. The front row of the teeth has nearly reached the vanishing point, being reduced to a single tooth in some species and having disappeared altogether in one. In the genus Piabucus, the breast is trenchant and the pectorals are enlarged. I have been inclined to place considerable taxonomic value on this character in the past, but I am sure now that it has several times appeared independently in different groups of the Characins.

D. The Stethaprioninæ

The Stethaprioninæ are like some of the Tetragonopterinæ, but have a procumbent predorsal spine. They are deep, compressed fishes, easily distinguished by the peculiar predorsal spine which, however, very probably does not indicate community of descent. Fowlerina, for instance, with three species, one in the Amazons and northward, another in the Paraguay, and another in the San Francisco, has been derived from Moenkhausia and very probably at least twice from different species, once in the San Francisco and once in Guiana. Stethaprion may have been derived from Ctenobrycon.

General Conclusions.

1. The Tetragonopterinæ are the dominant subfamily of South American Freshwater Fishes. They are found from tide level to the highest altitude attained by fishes in South America exclusive of Cyclopium and from Patagonia to New Mexico.

2. The same character may and does appear independently in various members of a homogeneous group of animals.

3. As a result of the independent origin of the same characters in different species, some of the genera of the Tetragonopterinæ are polyphyletic.

4. Species of different genera living together in some isolated area may be derived the one from the other and be more nearly related phylogenetically than they are to other members of the same genera in other areas.

5. Evolution is actively in progress, i. e., a number of species of Characins are in an unstable condition.

6. Material for evolution may appear in a widely distributed fish over its entire range, or

7. Material for evolution may appear in a distinct locality or restricted area of the range of a fish with very wide distribution while no such material appears in the general range.

8. The same new form may arise from a widely distributed species at isolated points or throughout its entire range wherever the suitable stimulus is present or wherever the proper selection is taking place.

9. Insignificant and unimportant characters like the scaling of the caudal may be a better indication of relationship than conspicuous organs whose modification may be of selective value.

10. Individuals of a long and firmly established genus sometimes revert to the characters of the genus from which it has arisen. Apparently members of the same brood may belong to different long recognized genera.

II. THE GLANDULOCAUDINÆ (A NEW SUBFAMILY OF CHARACID FISHES WITH INNATE POTENTIALITIES FOR SEXUAL DIMORPHISM.)

In 1858, Gill described three genera of fishes from the Island of Trinidad. Later studies have demonstrated that they represented respectively male, female, and young of a single species, *Stevardia albipinnis* Gill. Lütken and Regan secured additional specimens also on the Island of Trinidad. Within a year, the first specimens of the genus taken outside of Trinidad were collected at the base of the Cordilleras, east of Bogota; and they are described below as a new species.

In 1891, within a few weeks of each other, appeared descriptions of a fish from Montevideo by Perugia, Steindachner, and Holmberg. Perugia's name, *Pseudocorynopoma*, has priority. Perugia recognized the relationship between *Pseudocorynopoma* from Montevideo and *Stevardia*, one of whose synonyms is *Corynopoma*. A pair of living specimens of this species was given me by the aquariist, Mate, of Berlin; and many specimens of this species and of the new species described below were collected for the Carnegie Museum by Mr. Haseman.

In 1894, Cope secured a peculiar little fish from the Jacuhy in Rio Grande do Sul, which he described as *Diapoma speculiferum*. I am indebted to the authorities of the Philadelphia Academy of Sciences for the privilege of examining this type.

In 1908, Rebeiro described a fourth species, *Cœlurichthys iporangæ*, from southeastern Brazil. Its relationships were not pointed out by Rebeiro. Dr. Rebeiro kindly lent me the type, and Dr. Haseman collected many specimens for the Carnegie Museum.

In 1911, I described *Hysteronotus megalostomus* from the Rio das Velhas, a tributary of the Rio San Francisco, and three species of *Glandulocauda*, *melanogenys*, *inequalis*, and *melanopleura*, from southeastern Brazil. All of them were collected by Mr. John Haseman for the Carnegie Museum.

In December, 1912, I described three species of *Gephyrocharax*, *chocoensis*, *caucanus*, and *melanocheir*, which I had collected in transandean Colombia. A fourth species of this genus was described by Meek as *atricaudata* from the Canal Zone. Dr. Meek kindly lent me three specimens of his species.

In June, 1913, I described the remarkable little *Pterobrycon landoni* from a single specimen about an inch long which I had taken out of a little rivulet at Boca de Raspadura, Colombia.

Further study shows that these very diverse fishes, inhabiting the extreme northwest and extreme southeast corners of tropical South America, are related, all of them possessing the technical characters enumerated below.

As far as known individual species of this subfamily have restricted distributions which would point to the ready modification of the Glandulocaudinæ under different environments. Four species of *Gephyrocharax* occupy contiguous territory in Colombia and Panama; and three species of *Glandulocauda* are found in as many rivers of southeastern Brazil. *Cœlurichthys iporangæ* and possibly *Pseudocorynopoma doriæ* are exceptions, being found over wider territory, the former in the rivers emptying into the Atlantic between the Parahyba and some distance north of Rio Grande do Sul, and the latter from Rio Grande do Sul to Buenos Aires and Paraguay.

Of greatest interest is the *ability* to develop sexual dimorphism. In the majority of the Characins, the difference between the male and the female are not great. In the Glandulocaudinæ, however, the males frequently are quite different from the females, and of *particular interest is the fact that this difference sometimes appears in one organ and sometimes in another.* The opercle in the males of one species is excessively modified, some of the scales in another, the fins in still others; and generally there is a glandular pouch with specially modified scales on the caudal fin of the males in all of the species. In many of the species the lower caudal fulcra of the males are modified and may be separated as a spur from the rest of the fin.

A second point of general interest is the ability to produce a similar result by very diverse means. 'Adaptations arise whenever needed if they are at all possible.' If we grant that it is desirable to have a movable spot near the middle of the body, then this desideratum has been reached in *Stevardia* through the prologation of its opercle; in *Pterobrycon* by the prolongation of a scale; in one species of *Pseudocorynopoma* and one of *Gephyrocharax* by tipping the pectoral with black or brown. (Permanent black spots near the middle have been accomplished by one species of *Rhoadsia* and one of *Vesicatrus,* members of other subfamilies).

The mouth in all the species is oblique and the pectorals are

large. In one species, at least, the fish swims below its prey and then by a wing stroke of the pectorals lifts itself to the food.

In the related Tetragonopterinæ the differences between genera consist largely in the different combinations of a comparatively few characters; in the Glandulocaudinæ there is considerable originality as may be seen in the key to the genera.

Description of the Glandulocaudinæ

Premaxillary teeth notched, in two series, mandibulary and maxillary teeth in a single series.

Origin of dorsal distinctly behind the middle of the body except in *Glandulocauda melanopleura;* anal short or of moderate length; mouth very oblique, the lower jaw quite or nearly entering the profile; pectorals large, falcate, reaching beyond origin of ventrals, frequently to the anal; profile from dorsal to snout nearly straight, the ventral profile from chin to ventrals arched; second suborbital usually covering the entire cheek.

Sexual dimorphism very marked, the fins of the males frequently greatly exaggerated, the lower fulcra in the male frequently separate from the rest of the lower caudal lobe; caudal in the male with peculiar glandular scales or pouches covered by united scales, frequently split to the base in the middle; opercles or scales sometimes modified.

Distribution: Panama to the Pacific side of Ecuador, eastward through Colombia (and Venezuela?) to Trinidad; eastern (San Francisco) and southeastern Brazil (Parahyba to Rio Grande do Sul) and Uruguay to Paraguay. It has not so far been found in the Amazon basin.

Through *Landonia, Argopleura,* and *Bryconamericus henni* this subfamily is allied to the Tetragonopterinæ; through *Coelurichthys* and *Bleptonema* to the Aphyocharacinæ.

Key to the Genera of the Glandulocaudinæ

a. Opercles in male prolonged, ending in a dermal flap over the anal; fins in males very large; dorsal and anal rounded; last anal ray in male prolonged; lateral line complete. No adipose fin (Stevardiinæ).

I. Stevardia.

aa. Opercle notched above, prolonged to a point below; adipose fin present; last anal rays higher than those of the middle; lateral line developed in front and near caudal, not in middle. (Diapominæ).

II. Diapoma.

aaa. Opercle not prolonged.

b. A scale of the side prolonged, expanded into a dermal flap at its end, similar to the opercular flap in Stevardia; dorsal and anal rounded; last anal ray greatly prolonged; adipose fin present; lateral line incomplete; gill-membranes united (Pterobryconinæ). *III. Pterobrycon.*

bb. Sides without prolonged scales.

c. Preventral area trenchant; dorsal and anal in male enlarged; lateral line complete; adipose fin present. (Pseudocorynopominæ).

IV. Pseudocorynopoma.

cc. Preventral area not trenchant, more or less narrowly rounded; adipose fin present. (Hysteronotinæ).

d. Three lowest caudal rays separate from the rest of the fin in the male, the squamous pouch surrounding them and extending on the base of the lower caudal lobe only.

e. Anal with 30-34 rays; lateral line complete. V. *Gephyrocharax*.

ee. Anal 18; lateral line incomplete. VI. *Microbrycon*.

dd. Lower caudal rays not separate. (*Bryconamericus beani* and *Argopleura* of the Tetragonopterinæ).

f. Squamous pouch in male on the lower half of caudal; lateral line complete; A. 31-32.

g. Maxillary and mandibular teeth notched, the middle point longest and most prominent. VII. *Hysteronotus*.

(gg. Maxillary and mandible with very broad tipped teeth. *Landonia* of the Tetragonopterinæ).

ff. Squamous pouch in male on upper half of caudal. A. 26-34.

h. Lateral line incomplete. VIII. *Glandulocauda*.

hh. Lateral line complete. IX. *Coelurichthys*.

In the above key I have for convenience retained the subfamily names under which the species have been considered in the past.

Map Showing the Distribution of the Species of the Glandulocaudinæ.

The numbers in the circles refer to the numbers of the species in the text.

(Genera and Species of the Glandulocaudinæ with their Distribution)

I. STEVARDIA Gill.

Key to the Species of Stevardia

a. Last anal ray produced in both male and female; caudal in male divided to its base, the lower fulcra separated from the fin, forming a spur the basal scales of the lower lobe arching over a considerable cavity.

1. *aliata* Eigenmann.

aa. Last anal ray not produced; caudal in male not divided, without a basal spur and without united scales covering a pouch.

2. *albipinnis* Gill.

1. **Stevardia aliata**. Eigenmann sp. nov.

5215 C. M. Type, a male 75 mm. over all.

5489 C. M. 13180 I. U. M. Paratypes, 20, largest male 77 mm, Rio Negro, Villavicencio. Gonzales.

5490 C. M. 13181 I. U. M. Paratypes, 3, largest 51 mm. Rio Guadrigua. Gonzales.

Head to upper angle of gill-opening 4.5-5 in the length; depth 3.5; D. 10; A. 24-28; scales 6-43-6; eye a little longer than snout, a little less than interorbital, about 3 in the head to the base of the opercular process.

Dorsal outline straight or but little curved; ventral outline regularly arched from the chin to the end of the base of the anal; preventral area rounded or narrowly keeled, without distinct median series of scales; predorsal area rounded, with about 20 scales in a median series; occipital process short, about 1/8 in the distance from its base to the dorsal, bordered by two scales on each side; frontal fontanel a minute pore, parietal fontanel narrow except at the base of the occipital process, where it is rhomboid; cheeks entirely covered by the second suborbital; maxillary premaxillary about half as long as head to upper angle of gill-opening.

Mandible with five teeth, the second smaller than the first, rapidly graduate from the third which is nearly as large as the first; a few minute teeth on the sides; premaxillary with two to four teeth in the outer series and five in the inner; two or three teeth on the maxillary; teeth of the inner series of the premaxillary and of the front part of the mandible with a very large median cusp and two minute lateral cusps on each side.

Opercle in the female pointed, reaching to just above the base of the first pectoral ray; in the male prolonged in a style with an expanded dermal flap over the middle or posterior half of the anal; gill-rakers very short.

A few interpolated rows of scales from above the middle of the ventrals, the series deflected towards the anal; scales of the sides continued to form a sheath at the base of the anal; caudal in female naked, the scales at its base normal; scales of the lower caudal lobe of the male united and bulging over a large cavity between them and the caudal, the pouch open behind; each scale with a number of radials.

Fins very different in the two sexes; origin of dorsal equidistant from base of middle caudal rays and upper angle of gill-opening in the female, and the eye in the male, its height equal to length of head in female, greatly

prolonged in the male, reaching beyond origin of caudal; no adipose fin; caudal forked, in female, split to its base in the male, the lower lobe slightly longer than the upper in the female 3.5 in the length, much longer in the male 1.66 in the length; lower three caudal fulcra in the male separated from the rest of the fin as in *Gephyrocharax;* origin of the anal in front of the vertical from the front of the dorsal, its margin in the female rounded to the last rays which are slightly longer, similar but much higher in the male, the last ray expanded at the tip, which extends to the end of the separate lower caudal fulcra; ventral not reaching to the anal in the female, to beyond its origin in the male, the next to the inner ray at least as long as the longest; pectorals in the males reaching to or beyond origin of the anal, a little shorter in the female.

Middle caudal rays dusky.

2. **Stevardia albipinnis** Gill.

Stevardia albipinnis Gill, Fishes of Trinidad, 1858, p. 65.
Corynopoma riisei Gill, ibid. p. 66.
Nematopoma searlsii Gill, ibid, p. 69.
Habitat: Island of Trinidad, British West Indies.

II. **DIAPOMA** Cope.

3. **Diapoma speculiferum** Cope.

Diapoma speculiferum Cope, Am. Nat., 1894, p. 67.
Habitat: Rio Grande do Sul.

III. **PTEROBRYCON** Eigenmann.

4. **Pterobrycon landoni** Eigenmann.

Pterobrycon landoni Eigenmann, Indiana University Studies, 18, 1913, p. 3.
Habitat: Atrato basin, Colombia.

IV. **PSEUDOCORYNOPOMA** Perugia.

Key to the species of Pseudocoryhopoma

a. Anal in the male with an anterior lobe with narrow membranes and eight or nine (not counting the first two) broad rays with tubercles and 29-34 nontubercle-bearing rays; the margin of the fin simply emarginate or falcate; caudal divided to its base; dorsal reaching tip of adipose; pectorals, anal and caudal lobes not brown tipped; a black streak forward from anus; A. 37-44. 5. *heterandria* Eigenmann.

a. Caudal lobes with brown near the end in both sexes; anal in the male with an anterior lobe of very wide membranes and 7-10 narrow rays including the rudimentary ones, followed by a second much lower lobe of narrow membranes with 4-7 tubercle-bearing rays, finally 20-26 nontubercle-bearing rays, the margin of the fin double concave; anterior dorsal rays reaching to about middle of caudal; pectorals beyond origin of anal; frequently tips of pectorals, of rays of anterior anal lobe as well as tips of caudal, in male, black. A. 32-41, rarely more than 37.

6. *doriæ* Perugia.

5. **Pseudocorynopoma heterandria** Eigenmann, sp. nov.

5222 C. M. Type ♂, 80 mm. 5223 paratypes 3 males, largest 90 mm, 7 females, largest 92 mm. Xiririca. Dec. 8, 1908. Haseman.

Head 4.75; depth 2.66-2.9; D. 10; A. in males 2+8 or 9+29-34, total 40-44, sometimes 37 in females; scales 7-41 to 44-6; eyes 0.8-1 in snout, 3-3.66 in the head, 1.25-1.33 in the interorbital; depth of caudal peduncle equal to its length.

Compressed, elongate; dorsal profile arched very little; ventral profile greatly arched from chin to end of anal; ventral surface compressed, knife-like, the scales not lapping over the mid-ventral line except in front of pectoral; predorsal area rounded, with a medial series of about 13 scales in front of the dorsal and about 9 irregularly placed scales in front of them. Occipital process very short, about 1/13 of the distance from its base to the dorsal; skull convex, frontal fontanel narrow and short, shallow longitudinal grooves over the eye; second suborbital covering the entire cheek; mouth large, very oblique; maxillary-premaxillary border about 2.5 in the head; premaxillary with an outer series of usually 3, rarely 4, teeth and an inner series of 7; maxillary with 2 or 3 teeth; mandible with seven graduate teeth, the second below normal, the fifth to seventh decreasing very rapidly; several minute teeth on the sides.

Origin of dorsal much nearer base of caudal than to upper angle of the gill-opening; dorsal rounded, the seventh ray highest, reaching tip of adipose in the male, not to adipose in the female; adipose fin small; caudal divided to its base in the male; origin of anal in advance of the origin of the dorsal, emarginate in the female, falcate in the male, the rays forming the lobe (3-9th) with retrorse hooks; ventrals reaching to the anal in the male, much shorter in the female; pectorals to near anal in both sexes.

Lateral line complete, moderately decurved, axillary scales small; caudal naked except for a few scales at the base of the lower lobe, the skin at the base of the fin tumid, a large space arched over by united scales at the base of the lower rays just below the middle, the opening bordered by a leaf-like scale above and a twisted scale below and behind; scales regularly arranged except over and a little in front of the anal, the rows deflected and continued to form a loose sheath at the base of the anal.

A black spot on base of middle caudal rays; streak in front of anus in male black; lower lip dark; no other markings.

6. **Pseudocorynopoma doriæ** Perugia.

Pseudocorynopoma doriæ Perugia, Ann. Mus. Genova, ser. 2. X, 1891. p. 646, fig.

Bergia altipinnis Steindachner, Anz. Ak. Wien. 1891, p. 173.

Chalcinopelecus argentinus Holmberg, Revista Argentina, 1891, p. 190.

Habitat: La Plata basin, Rio Grande do Sul.

5219 C. M. 7, largest a female, 75 mm. long. Uruguayana. Feb. 5, 1909. Haseman.

5220 C. M. 7, males, the largest 63 mm. 12 females, the largest 71 mm. Cacequy. Jan. 31, 1909. Haseman.

5221 C. M. 23 males, the largest 70 mm., over 100 females, the largest 68 mm. Cacheoira, Rio Jacuhy. Jan. 26, 1909. Haseman.

It is not certain that the specimens before me all belong to the species figured by Steindachner and Perugia. Both figure the dorsal and the anal as symmetrical, one gives the anal as 42, the other as 32. Neither saw the double lobing of the anal, nor the divided caudal, nor the glandular pouch on the caudal. There is, however, no doubt about the generic identification, and Perugia noticed the black caudal tips.

Head 4.25; depth 2.5-2.75; D. 10; A. $\frac{32}{2}$, $\frac{34}{3}$, $\frac{35}{1}$, $\frac{36}{3}$, $\frac{37}{2}$, $\frac{38}{1}$, $\frac{41}{1}$; scales 7-41 to 43-6; eye 3-3½ in the head, 1.25 in interorbital; depth of caudal peduncle equal to its length.

Compressed; ventral profile much more strongly curved than the dorsal; profile from snout to dorsal nearly straight, angulated at the origin of the dorsal; entire ventral surface compressed, knife-like, without scales across the median line except near the isthmus; predorsal area rounded, without a median series of scales; occipital process very short, skull convex, with longitudinal grooves above the eye; frontal fontanel very short and narrow, parietal club-shaped; second suborbital covering the entire cheek; mouth large, very oblique, maxillary-premaxillary border little less than half the length of the head; mandible with six graduated teeth (the second below the normal in size) and several minute ones on the sides; premaxillary with an outer series of three teeth and an inner series of six or seven; maxillary with one to seven teeth. All the larger teeth with a strong median cusp and two lateral cusps.

Origin of dorsal about equidistant from base of middle caudal rays and upper angle of gill-openings, the margin truncate in the female, the end of the rays subequal, the anterior four (beyond the rudimentary one) in the male variously prolonged, reaching to the middle of the caudal in extreme cases. Caudal lobes similar in the two sexes, the fin split to its base at the middle in the male, base of the rays just above the divide tumid, a cavity at the base of the rays just below the middle arched over by connected scales, the cavity open behind, the opening guarded by a leaf-like scale above and a firm, narrow scale curved so as to form the lower border and also the posterior border; anal simply emarginate in the female and younger males, three-lobed in the mature males, the anterior lobe consisting of 7-10 narrow rays separated by wide membranes, the second to fourth ray highest, reaching beyond tip of last in extreme cases, the second lobe consisting of 4-7 rays bearing retrorse hooks along the posterior lateral face, the rays broader, the membrane narrower than on the first lobe, the remainder of the fin as in the female; ventrals short, not reaching anal; pectorals about to tips of ventrals in the female, to the anal in the male.

Lateral line complete, but little decurved; axillary scales small, caudal naked except as stated above for the males; scales with several radials, regularly imbricate except over and a little in front of where the rows are deflected toward the anal and continued as a sheath of about three rows along the base of the anal but not attached to the fin.

Silvery; prolonged dorsal rays dusky; tips of caudal lobes with short oblique or brown bars; rays of anterior lobe of the anal of the male frequently black tipped; tips of pectorals in the male usually black.

V. GEPHYROCHARAX Eigenmann.

Key to the Species of Gephyrocharax

a. Caudal with a black spot at its base.

b. Tips of pectorals and belly, in the males, without black; no dark spot at base of first dorsal ray; males like the females except in the caudal; distance between origin of dorsal and base of middle caudal rays 2.5-2.8 in the length. Depth 3-3.25. 7. **chocoensis** Eigenmann.

bb. Tips of pectorals in the males without black; belly from anal to the ventrals black; a dark median streak from ventrals to pectoral; distance between middle of caudal and origin of dorsal about 2.8 in the length; depth 4. 8. **caucanus** Eigenmann.

bbb. Tips of pectorals in the males black, a dark spot at base of first dorsal ray; distance between origin of dorsal and base of middle caudal rays about 2.6 in the length; depth 3-3.3. 9. **melanocheir** Eigenmann.

aa. Base of caudal with a black bar which extends part way along the middle caudal rays and further on the outer rays.

10. **atricaudata** Meek and Hildebrand.

7. Gephyrocharax chocoensis Eigenmann.

Gephyrocharax chocoensis Eigenmann, Indiana University Studies, 16, 1913, p. 23.

Habitat: Rio San Juan basin, Pacific slope of Colombia, and Atrato basin, Atlantic slope of Colombia.

8. Gephyrocharax caucanus Eigenmann.

Gephyrocharax caucanus Eigenmann, Indiana University Studies, 16, 1913, p. 24.

Habitat: Upper Cauca basin, Colombia.

9. Gephyrocharax melanocheir Eigenmann.

Gephyrocharax melanocheir Eigenmann, Indiana University Studies, 16, 1913, p. 24.

Habitat: Magdalena basin from the coast to Honda.

10. Gephyrocharax atricaudata (Meek & Hildebrand.)

Deuterodon atricaudata Meek and Hildebrand, Field Museum Publications, 158, p. 68.

Habitat: Panama Canal Zone.

VI. MICROBRYCON Eigenmann & Wilson.

11. Microbrycon minutus Eigenmann & Wilson.

Microbrycon minutus Eigenmann, Indiana University Studies, 19, 1914, p. 3.

Habitat: Truando, tributary of the Atrato, Colombia.

VII. HYSTERONOTUS Eigenmann.

12. Hysteronotus megalostomus Eigenmann.

Hysteronotus megalostomus Eigenmann, Ann. Carnegie Museum, VIII, 1911, p. 171.

Habitat: Rio das Velhas, tributary of the Rio San Francisco, Brazil.

VIII. GLANDULOCAUDA Eigenmann.

Key to the Species of Glandulocauda

a. Much compressed, deep; depth of caudal peduncle greater than its length; origin of anal and dorsal about equidistant from snout.

b. A. 26; scales 8-40-7; teeth five-pointed; cheeks dark; lateral line with 11-17 pores. 13. *melanogenys* Eigenmann.

bb. A. 27-33; scales 7-38-6; teeth three-pointed; cheeks silvery; lateral line with 6 or 7 pores. 14. *inequalis* Eigenmann.

aa. Less compressed; depth of caudal peduncle less than its length; origin of dorsal in advance of that of the anal; A. about 20; depth 3.33; scales 5-33-5; lateral line with 5-7 pores. 15. *melanopleura* Eigenmann.

13. Glandulocauda melanogenys Eigenmann.

Glandulocauda melanogenys Eigenmann, Ann. Carnegie Mus., VIII, 1911, p. 168.

Habitat: Alto da Serra, Rio Tieté, Sao Paulo, Brazil.

14. Glandulocauda inequalis Eigenmann.

Glandulocauda inequalis Eigenmann, Ann. Carnegie Mus., VIII, 1911, p. 169.

Habitat. Porto Alegre, Rio Grande do Sul.

15. Glandulocauda melanopleura Eigenmann.

Glandulocauda melanopleura Eigenmann, Ann. Carnegie Mus., VIII, 1911, p. 170.

Habitat: Rio Iguassú, above the falls, tributary to the Paraná.

IX. COELURICHTHYS Ribeiro.

16. Cœlurichthys iporangae Ribeiro.

Cœlurichthys iporangæ Ribeiro, Kosmos, 1908.

Habitat: Rio Macacos, Rio Itapemerim into Atlantic north of Rio de Janeiro; Rio Mogy, into Santos Bay; Rio Iguapé, into Atlantic south of Santos; Rio Nhundiaquara basin into Atlantic at Paranagua.

III. ON THE RESEMBLANCE BETWEEN THE FAUNAS OF TRANSANDEAN COLOMBIA AND SOUTH-EASTERN TROPICAL AMERICA

One group of genera of the Glandulocaudinæ, Pterobrycon, *Gephyrocharax* and *Stevardia*, is found in northwestern South America, the first two being, as far as known, found west of the Eastern Cordilleras of Colombia. The remaining genera are found at the opposite corner of the tropical region of South America; that is to say, in southeastern Brazil and Uruguay. If they are found between these two regions they have so far not been observed there.

The distribution of the Glandulocaudinæ indicates similar physical conditions or similar origin for the faunas of transandean Colombia and Southeastern tropical South America.

Of like import is the distribution of the genus Salminus. One species is found west of the Eastern Cordilleras of Colombia and the other one is found in the La Plata basin. A somewhat similar condition is found in the distribution of the genera *Pseudochalceus* from western Ecuador and its nearest relative *Hollandichthys* from southeastern Brazil. Furthermore, the genus *Bryconamericus* finds its greatest development along the Cordilleras of Ecuador and Colombia and in the La Plata basin to Rio Grande do Sul. Similarly, the species *Astyanax fasciatus* reaches its greatest development and has diverged into the largest number of varieties west of the Eastern Cordilleras of Colombia and in southeastern Brazil.

There is evidence that the similarity between the faunas of the region west of the Eastern Cordilleras of Colombia and the southeastern corner of the tropical regions of South America is not confined to positive resemblances, but that a number of types absent from northwestern Colombia are also absent from southeastern Brazil to Buenos Aires. The details in the distribution will be pointed out later.

IV. NEW GENERA AND SPECIES OF SOUTH AMERICAN FISHES

X. **BLEPTONEMA** Eigenmann.

General Appearance of Gephyrocharax:

Teeth tricuspid, in a single series on mandible, premaxillary and along entire edge of maxillary; adipose fin well developed; first and second developed anal rays filigerous, curved; pectorals placed low, long and falcate, their margins nearly along the edge of the compressed belly when the fin is closed; lateral line incomplete; mouth very oblique; profile from tip of snout to near dorsal straight; origin of dorsal behind the middle.

17. **Bleptonema paraguayensis** Eigenmann sp. nov.

5499a C. M. Type, 40 mm. to base of caudal; 5499 C. M. paratypes, six, the largest over 50 mm. Corumba. April 27, 1909. Haseman.

Head 4.66-5; depth 3.33; D. 10, rarely 11; A. 31-34; lateral line 8 to 11+26 to 28=36 to 38, 8 between ventrals and dorsal; eye 3 in the head, about equal to interorbital.

Elongate, compressed. Breast with a series of large median scales; belly between pectorals and ventrals trenchant, the margins of the scales of one side bent over the middle line; no median series of scales; predorsal with a median series of about 16 scales, the series less regular near the occipital process which extends about one-eighth to the dorsal; skull smooth convex; frontal fontanel large, triangular, a little more than half the length of the parietal; second suborbital in contact with both the posterior and lower limb of the preopercle; mouth very oblique, maxillary-premaxillary border a little more than orbital length; about 20 teeth on the maxillary, those on the posterior half larger, pointing backward and outward; seven premaxillary teeth; mandible with six or seven tricuspid teeth, the first and last distinctly larger than the middle ones, abruptly several minute teeth on the sides.

Origin of dorsal nearer base of middle caudal rays than to the eye; origin of anal in front of the dorsal; first developed anal ray heavy and much prolonged, the second less so, outer ventral ray filiform, extending beyond the origin of the anal, pectorals to near the middle of the ventrals; pectorals placed, low, their base oblique, their shortest ray about .2 of the outer ray, which is similar to the outer ventral and first developed anal ray.

Scales everywhere regularly imbricate, with few radials, a series of very small scales along the base of the anal, caudal naked; axillary scales small.

No color markings; margin of anal in the male dusky.

18. **Bleptonema amazonæ** Eigenmann sp. nov.

5497a C. M. type, 54 mm., 5498 a-c C. M. paratypes, three, 50-55 mm. Santarem. Dec. 9, 1909. Haseman.

This species is very similar to *paraguayensis*.

The scales are 8 to 14+26 to 30=38 to 41, 9 or 10 between ventrals and

dorsal; the anterior anal rays are much shorter; the origin of the dorsal is equidistant from the base of the middle caudal rays and the anterior margin of the eye.

XI. PARECBASIS Eigenmann gen. nov.

Teeth tricuspid, in a single series on anterior part of mandible and premaxillary, none on the maxillary and sides of mandible; an upper narrow part of the maxillary heavy, abruptly a thinner, blade-like expanded portion ending in the convex free margin; sides of mandible edge raised; adipose fin well developed; caudal partly scaled; lateral line complete.

19. **Parecbasis cyclolepis** Eigenmann sp. nov.

5495 C. M. type, 74 mm., 5496 C. M. paratype, 80 mm. San Antonio, de Rio Madeira. Nov. 3, 1909. Haseman.

Head 4; depth 2.75; D. 11; A. 24; scales 6-38-5; eye 3+ in the head, equal to interorbital.

Compressed, fusiform in outline, the dorsal and ventral outlines equally symmetrically curved; preventral area rounded, with a nearly complete median series of 14 scales, predorsal area rounded, with a median series of ten scales; occipital process bordered by four scales, extending one-fourth to dorsal; skull convex in cross-section; frontal fontanel 4 times as long as the parietal; second suborbital in contact with both the vertical and horizontal limb of the preopercle, covering entire cheek, maxillary not reaching to below eye; mouth clupeoid, the premaxillary transverse, without an antero-posterior extent; teeth minute, confined to the premaxillary and the portion of the mandible in contact with it when the mouth is closed.

Origin of dorsal equidistant from tip of snout and end of adipose or a little nearer the latter; dorsal falcate; origin of anal below last dorsal ray, faintly emarginate; origin of ventral below origin of dorsal, just reaching anal, or a little shorter; pectorals short, just about reaching ventrals.

Scales thin, the margins convex, with many radials; lateral line but little decurved; anal naked; caudal lobes scaled for one-fourth of their length.

A small, but conspicuous humeral spot, about equal to the size of the pupil, over the fourth scale of the lateral line; a faint dusky streak parallel with the margin in the middle and upper lobe of the caudal, the rays beyond them dotted.

20. **Fowlerina franciscensis** Eigenmann sp. nov.

5240 C. M. Type 72 mm. and 5561 C. M. Paratypes 46-72 mm. Barreiras, Lagoa of Rio Grande. Jan. 3 and 4, 1908. Haseman.

5566 C. M. Paratypes, 18, 46-73 mm. Lagoa de Porto. Dec. 24, 1907. Haseman.

5565 C. M. Paratypes, 4, Jaozeiro. Nov. 28, 1907. Haseman.

5567 C. M. Paratypes, 27, 51-79 mm. Piropora. Dec. 15, 1907. Haseman.

5564 C. M. Paratypes, 2, 61-63 mm. Cidade do Barra. Dec. 6, 1907. Haseman.

5562 C. M. Paratypes, 2, about 23 mm. Rio Grande, Cidade do Barra. Dec. 26, 1907. Haseman.

5563 C. M. Paratypes, 7, 46-57 mm. Lagoa de Pereira. Dec. 23, 1907. Haseman.

5568 C. M. Paratypes, 7, 31-63 mm. Boqueirao near mouth of Rio Preto. Jan. 6, 1908. Haseman.

5569 C. M. Paratypes 40, 32-67 mm. Penedo. March 20, 1908. Haseman.

5570 C. M. Paratypes, 23, largest 75 mm. Santa Rita. Jan. 24, 1908. Haseman.

M. C. Z. 3, 60-80 mm. Rio San Francisco below the falls. 1867. Hartt.

This species, first collected by Hartt in 1867, was found by Haseman in the San Francisco from its mouth to Piropora. It is as far as known confined to the San Francisco basin.

In the Paranahiba just north of the San Francisco basin, *F. orbicularis* is found.

Most readily distinguished by its simple, spine-like, predorsal spine.

Head 3.75; depth about 1.7-2; D. 10 or 11; A. 34-38; scales 8-33 to 37-8; eye 2.75 in head, a little greater than interorbital.

Compressed, the more elongate specimens oval, the deeper ones subrhomboidal, the deepest point at the origin of the anal; preanal region very narrowly rounded; predorsal, in part, with a naked median line, in part with the scales of one side or the other bent over the ridge; occipital process about 3 in the distance from its base to the first dorsal ray, bordered by about 5 scales along each side; nape depressed; interorbital broad, convex; frontal fontanel equal to the parietal; second suborbital leaving a wider naked border below than behind; maxillary-premaxillary border 2-2.5 in the head; usually four teeth in the outer row of the premaxillary, five in the inner; maxillary with two teeth; mandible with four large teeth, the second out of line, and five to seven minute teeth anteriorly on the sides, the greater part of the sides of the lower jaw being without teeth.

Predorsal spine narrow, pungent, without lateral hooks, about three-fourths as long as the eye; dorsal variously falcate, the third ray highest, in extreme cases reaching the caudal, sometimes only two-thirds to tip of adipose; origin of dorsal a little nearer snout than caudal; origin of anal about under middle of dorsal, for the most part low, its anterior lobe composed of but few rays, the second of the developed rays highest, sometimes reaching middle of caudal; ventrals small, just reaching anal; pectorals small, reaching to above middle of ventrals.

Scales everywhere regularly arranged except over anal muscles, where the rows are but slightly deflected; a sheath of two rows of scales on the anterior part of the anal, none on the last, the scales in the middle of the fin attached to the membranes, in front not attached; caudal lobes scaled, the scales extending a little further on the lower lobe.

Prolonged rays of dorsal and anal, black. Two faint humeral bars in the darker specimens.

21. **Agoniates anchovia** Eigenmann sp. nov.

5216 C. M. Type 127 mm., 5217 C. M. Paratypes, nine, 87-108, mm. Villa Bella. Haseman.

Head 5; depth 4.75-5; D. 11; A. 31-34; scales 5-45 to 48-4; eye 1.25 in snout, 4.2 in head, 0.8 in interorbital.

Long and slender; head compressed, anchovy-like; preventral area

keeled, prepectoral ridge being very sharp; predorsal area rounded, without a complete median series of scales; dorsal profile nearly straight from tip of snout to dorsal; ventral profile regularly arched from the chin to the ventrals; occipital process about 13 in the distance from its base to the dorsal; skull slightly rounded, narrowed forward; frontal fontanel extending to above the anterior margin of the pupil, narrower than the parietal but of about equal length; mouth very oblique, narrow, a distinct angle between the premaxillary and the maxillary, whose upper anterior margin is rounded; lower jaw with about 10 conical teeth, the first small, the next two larger and equal, the third very long, the middle one of the remainder largest; a pair of small conical teeth behind the first pair of the front series; premaxillary with three conical teeth in an outer series and four long conical teeth graduated from the large first one, a minute notch on one or both sides of these teeth near their tip; maxillary with about 20 conical teeth, smallest and close set near the premaxillary; second suborbital leaving a wide naked margin; gill-rakers 7+13, the lower limb of the arch long; adipose lid leaving only the pupil free.

Lateral line complete, sharply decurved on its first four scales and then running straight to the middle of the lower caudal lobe; fins naked; axillary scales large, a large flap just above the pectoral more than half the length of the head.

Dorsal very small, its origin equidistant from base of middle caudal rays and head or nearer the former; adipose fin small; anal low, its origin under the origin of the dorsal; ventrals very small, almost half as long as the head; pectorals large, longer than head.

A dusky stripe from upper angle of opercle to the middle of the caudal.

22. **Astyanax scabripinnis paranae** Eigenmann var. nov.

Type 11631 I. U. M. 139 mm. Parana, von Ihering.

Paratypes 11632 I. U. M. 62-127 mm. Parana, von Ihering.

3402 C. M. Three[1], 83-95 mm. Rio Grande, below the falls near Bom Jardin. July 8, 1908. Haseman.

3403 C. M. Five[2], 59-about 90 mm. Rio Grande, above water-fall, near Bom Jardin, July 7, 1908. Haseman.

3404 C. M. Forty-three[3], 31-105 mm. Burmier, May 14, 1908. Haseman.

3405 C. M. Three, 31-40 mm. Mogy das Cruzes, July 19, 1908. Haseman.

3406 C. M. Nine, 32-65 mm. Alta da Serra, July 25, 1908. Haseman.

3407 C. M. Nine, 37-53 mm. Mogy Guassu, Aug. 25, 1908. Haseman.

3408 C. M. One, 49 mm. Rio Paranahyba, Aug. 15, 1908. Haseman.

3409 C. M. Ten, 26-68 mm. Bebedouro, Sept. 1, 1908. Haseman.

3410 C. M. Four, largest 59 mm. Piracicaba, Sept. 7, 1908. Haseman.

3411 C. M. Two hundred twenty-nine, the largest 129 mm. Serrinha, Parana, Rio Iguassu, Dec. 22, 1908. Haseman.

3412 C. M. Twenty-five, the largest 87 mm. Porto Uniao, Rio Iguassu, Dec. 28, 1908 Haseman.

Head 3.6; depth 2.6 in females, 3.66 in males; A. 17-23; scales 6 or 7-37 to 41-5 or 6; eye 5 in the head in the old, interorbital 3.25; snout 3.5; maxillary 3 in the largest female, 4 in the largest male; premaxillary-

[1]A. 18, 17, 17.

[2]Two with A. 17, three with A. 18.

[3]Anal in four with 19, 17, 17, 18 rays.

maxillary border nearly half the length of the head in the largest female, shorter in the younger females and in the males.

Heaviest at end of pectorals; preventral area broad, rounded, with irregularly placed scales; postventral area rounded, rather broad; predorsal area broad, completely scaled but without a distinct median series of scales; about 13 series of scales in front of the dorsal.

Occipital process 6 in the distance from its base to the dorsal; interorbital smooth, convex; second suborbital short and deep, its margin very convex, leaving a narrow naked area of about equal width around its entire margin in the females, in the males much less convex, the naked area much wider. Outer series of premaxillary with three to five teeth, inner row with five teeth, the tooth at the symphysis three-pointed, the rest five-pointed incisors. Maxillary with one to seven teeth, the outermost sometimes conical, the innermost three-pointed. Mandible with four large teeth, two smaller ones and about eight minute ones, all about five-pointed, the middle-point much the longer. Scales cycloid, with very many (often twenty or more) diverging striæ, regularly imbricate, except just over the origin of the anal, the exposed edges of the scales of the sides about half as wide as high; caudal naked; anal sheath of a single series of inconspicuous scales confined to the first nine anal rays; lateral line but little decurved, the row of scales below it parallel with it.

Origin of dorsal equidistant from tip of snout and last scale at base of middle caudal rays, its penultimate ray half as high as the highest, which is 6 in the length; anal slightly emarginate, its origin behind the vertical from the last dorsal ray, its base just equal to the distance between the dorsals or shorter, 4 in the distance from the pupil to the caudal in the largest female, 6 in the length in the largest male; ventrals a little, if any, in advance of the origin of the dorsal, short and rounded, reaching to the anus; pectorals quite small, reaching half-way to the middle of ventrals in the largest female, a little further in the largest male.

A vertical humeral bar just behind the opercle, a silvery lateral band becoming dark toward the caudal and continued, but much narrower on the middle caudal rays the continuation on the caudal being sometimes scarcely apparent.

23. **Pygidium hasemani** Eigenmann sp. nov.

5238 C. M. type, 5239 C. M. paratypes, many, largest 18 mm. Santarem. Dec. 11 ,1909. Haseman.

This species resembles *Pygidium amazonum* (Steind.) in the posterior position of the dorsal. The origin is on the vertical or a little posterior to the vertical from the anal.

Head 5.5; depth 7; D. 7 or 8; A. 6 or 7; caudal with 12 radiating rays and numerous accessory rays, both above and below. Eyes about 5 in the head, about 2 in the interorbital; posterior margin of eye in advance of middle of head; poctoral prolonged in a filament; maxillary barbel not extending beyond the preopercular spines; pectoral about equal to length of head; ventrals but little over half length of head. A series of about 8 diffuse dusky spots along the middle of the back in front of the dorsal; middle of sides with about 8 minute more intense spots, the last of which is at the base of the middle caudal rays.

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INDIANA UNIVERSITY STUDIES

No. 21. COOPER IN GERMANY. By Preston A. Barba, Ph. D.

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INDIANA UNIVERSITY STUDIES

No. 21 BLOOMINGTON, INDIANA MAY 15, 1914

Prefatory Note

The manner of their reception and the subsequent influence in Europe of the works of James Fenimore Cooper, the first American man of letters to gain general recognition beyond the Atlantic, must be of some interest to the student of American literature. In no country was Cooper's influence more vital than in Germany. The study here presented takes up Cooper in his relations to that country. It is hoped that it may be not entirely without value as a contribution to the history of German American cultural relations. This study appeared first in the *German American Annals* (a continuation of the quarterly *Americana Germanica*), Jan.-Feb., 1914. The Editor, Professor Marion D. Learned, of the University of Pennsylvania, has very kindly consented to this republication.

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Feb. 21, 1914.

Accepted for publication in the Indiana University Studies.

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Cooper in Germany

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I. INTRODUCTION

However highly we may regard the works of the earlier epochs of American literature, the fact nevertheless remains that prior to the third decade of the nineteenth century not one of its writers was recognized in Europe as having produced a work typically American. Charles Brockden Brown, Washington Irving, and James K. Paulding had not been altogether unmindful of the literary asset which the new world offered to the writers of fiction. Brown had not hesitated to introduce the American Indian in his Gothic romance 'Edgar Huntley' (1799); Irving had written interesting accounts of his travels in western America in 'Astoria' (1836) and the 'Adventures of Captain Bonneville' (1837); Paulding, far more national than Irving and Brown, had given excellent portrayals of life among the early settlers of New York and Kentucky in 'The Dutchman's Fireside' (1831) and 'Westward Ho!' (1832). Not one of these writers, however, was in any way representative of that great Americanizing spirit which moved always westward and in the course of half a century established a republic extending from the Atlantic Ocean to the Pacific. Certainly the opening up of western America must be looked upon as one of the greatest achievements of the nineteenth century. On its frontier, ever receding before the impatient forward surge of the young nation, were enacted the deeds for its future epics. The first to seize upon and exploit this immeasurable wealth of literary material with adequacy was James Fenimore Cooper.

Although he had had little literary schooling, Cooper was in some respects admirably fitted for his work. He was distinctly an American product, remarkably free from old-world culture, and extremely national in his views. His entrance upon a literary career was quite accidental and when his first novel 'Precaution' appeared he was already thirty-one years of age. His second work, 'The Spy,' enjoyed an unprecedented success at home and was translated into the various languages of Europe. Cooper was soon recognized as the first representative American writer. To

him belongs the credit of having given American literature a respectable place beside the literatures of Europe. From his works the European first received a comprehensive idea of American life, and of the social and political aspirations of the new republic.

Cooper's popularity spread to nearly all of the civilized countries of the world, and rose to a height perhaps unparalleled in the history of fiction. Lounsbury, in his excellent biography of Cooper, quotes the following passage from a letter written by the inventor Morse in defense of Cooper: "I have visited, in Europe, many countries, and what I have asserted of the fame of Mr. Cooper I assert from personal knowledge. In every city of Europe that I visited the works of Cooper were conspicuously placed in the windows of every bookshop. They are published as soon as he produces them in thirty-four different places in Europe. They have been seen by American travelers in the languages of Turkey and Persia, in Constantinople, in Egypt, at Jerusalem, at Ispahan." William Cullen Bryant, in his 'Commemorative Discourses,' gives further testimony to Cooper's popularity in Europe. He writes: "A gentleman who had returned from Europe just before the death of Cooper was asked what he found the people of the Continent doing. 'They all are reading Cooper,' he answered; 'in the little Kingdom of Holland, with its three millions of inhabitants, I looked into four different translations of Cooper in the language of the country.' A traveler, who has seen much of the middle classes of Italy, lately said to me: 'I found that all they knew of America, and that was not little, they had learned from Cooper's novels.' "

The works of an author so intensely American by temperament could not have been so widely read by the peoples of Europe without also affecting their subsequent literature. In no country was Cooper's influence more vital than in Germany.

When the German translation of 'The Spy' made its appearance in Germany in 1824 there was no German novelist, who pre-eminently commanded the attention of the reading public. The only notable contributions to German novelistic literature in the immediately preceding years were the fragmentary 'Kronenwächter' (1817) of L. A. von Arnim, 'Wilhelm Meisters Wanderjahre' (1821) of Goethe, and several of the phantastic novels of E. T. A. Hoffmann. The one dominating influence in German fiction at this time was a foreign one, namely that of Walter Scott, whose works had been appearing in German since 1815. Cooper's usurpation of Scott's place in the hearts of the German reading public

and his great popularity among the lower classes, are to be explained, at least in part, by the nature of the contents of his novels. Cooper had, so to speak, broken virgin soil in the domain of literature. In the primeval forests of Cooper's novels the tired spirits of Europe found a fresh and invigorating atmosphere. Then, too, the people were fascinated by the splendid portrayal of life among the aborigines, for the employment of the American Indian as a legitimate character for purely literary purposes was new. The American Indian himself was, however, by no means a novelty to the Germans. A quarter of a century before, Chateaubriand had made him the medium for the conveyance of Rousseau's doctrine of the goodness of primitive man, a doctrine which was an outgrowth of the prevailing social discontent in Europe. Chateaubriand's 'Atala,' 'Rene,' and 'Natchez,' with their poetic but weak portrayals of Indian life in America, had enjoyed great popularity, and translations of them were widely circulated in Germany.[1] The American Revolution had also served to call attention to the American Indian, and he was made the subject of several poems. Herder had occupied himself with the Indian in his 'Ideen zur Philosophie der Geschichte der Menschheit' (1784-1791). Ethnographical works and journals of travel had further helped to cultivate an interest in the American Indian.

But even more attractive to the German reader than the Indian were Cooper's pictures of American life, especially frontier life, which appealed directly to the Germans who at this time took great interest in America. It was the period preceding the reaction commonly known as the "Young German" movement. Germany was suffering political ignominy. Under the fearful rule of Metternich there was little hope that the German's dream of the centuries, a united Fatherland, could ever be realized. A last resort for the afflicted German lay in the young republic beyond the sea. The word "Amerika!" was an open sesame which presented undreamed prospects. In 1817 the great emigration to America had begun and continued for more than half a century, until there was hardly a family in the remotest German village which had not a kinsman or friend in America. The novels of Cooper were therefore eagerly read by old and young. Through them the prospective emigrant learned much about the new country, whither he hoped to go. On the other hand, those who remained at home found assuagement in these works for that deepseated indefinable

[1] Cf. My article 'The American Indian in German Fiction.' German American Annals. May-August, 1913.

weariness aptly termed "Europamüdigkeit." In a consideration of Sealsfield, Julian Schmidt wrote: "Aus der Verkümmerung unsrer Verhältnisse entspringt die Sehnsucht nach Urwäldern, nach Indianern und andern Naturproducten. Ein Volk mit einer reichen Geschichte und einem gesunden gesellschaftlichen Lebenvertieft sich lieber mit Walter Scott in die Ruinen seiner grossen Vorzeit, oder mit Dickens in das geschäftig bunte Treiben seines Markts, als dass es mit dem letzten Mohikaner für das freie Jagdrecht am Mississippi schwärmen sollte. Unser Interesse an Nordamerika hat immer noch einen romantischen Anstrich; das dunkle Gefühl von der Krankhaftigkeit unsrer eignen Zustände, nicht ein bestimmtes Bewusstsein über das, was wir eigentlich suchen, treibt uns über den Ozean."[2]

It is my purpose here to trace the influence of Cooper's works on German writers and also to add some Cooperiana which have come to my notice, hoping that this material, fragmentary as it is, may be of some value to the historian of American literature, as well as of German American relations.

[2] See his 'Geschichte der deutschen Literatur seit Lessings Tod.' Lpz. 1858, s. 213.

II. COOPER'S INFLUENCE ON GERMAN LITERATURE

A molding factor in the development of the historical novel in Germany is to be found in the works of Walter Scott. Only upon their appearance was the vast storehouse of the German past in all its aspects opened to fiction. Scott's novels, by their very nature, readily lead to imitation. It was only necessary to apply Scott's method to German history. The most successful of Scott's many followers were Wilhelm Hauff (1802-27) and Willibald Alexis [W. H. Häring] (1798-1871). The latter had actually passed off his first novel 'Walladmor' (1825) successfully as the work of the great Scotch novelist. Cooper's novels, on the contrary, could not in the same way be transplanted into German soil; nor did their nature admit of imitation readily unless by writers who were acquainted with conditions in America. The works of Cooper, though more widely read than Scott's, therefore at first exerted an influence far less apparent.

GOETHE.—In spite of his advanced age Goethe took a keen interest in the literary activities of the younger generation. Goethe's interest in America are well known. Since 1816 he had at various times received visits from Americans. He also made efforts to acquaint himself with the geography of America, its forms of government, the conditions among its people, and the explorations carried on there. In 1819 he had exclaimed to the American, Cogswell: "Wären wir zwangig Jahre jünger, so segelten wir nach Amerika."[3] In the same year he read the account of Lewis and Clark's expedition; in 1822, Struve's work on 'Northamerican Mineralogy;' in 1823, Irving's 'Sketchbook.'[4] Ludwig Gall's 'Auswanderung nach den Vereinigten Staaten" (1822) interested him and he suggested the contents of the same as new and valuable material for the younger generation of novelists.

"Der Bearbeitende," he says, "müsste den Stolz haben, mit Cooper zu wetteifern, und deshalb die klarste Einsicht in jene überseeischen Gegenstände zu gewinnen suchen."[5]

The first translations of Cooper's works into German were those of 'The Pioneers' and 'The Spy,' which appeared as early as 1824. However, it was only in 1826 that Goethe took up the reading of Cooper. From his 'Tagebücher' we learn that he was reading

[3] Cf. Horatio S. White's 'Goethe in Amerika.' 'Goethe Jahrbuch.' 5. Bd. 219 ff.

[4] Cf. Leonard L. Mackall's 'Briefwechsel zwischen Goethe und Amerikanern.' 'Goethe Jahrbuch. 25. Bd. s. 3.

[5] See 'Stoff und Gehalt, zur Bearbeitung vorgeschlagen, Goethe's Werke.' Cottasche Ausg. (Goedeke) Bd. 18, s. 261 f.

'The Pioneers' from September 30 to October 2, 1826; 'The Last of the Mohicans,' October 15-16, 1826; 'The Spy,' October 22-24, 1826; 'The Pilot,' November 4; 'The Prairie,' June 23-27, 1827; 'Red Rover,' January 21-29, 1828. These readings bore direct fruit in a work upon which Goethe was then engaged. As early as 1797 Goethe had been occupied with material for an epic, of which Schiller had in its embryonic state spoken as the "Lowen- und Tigergeschichte," and also called it "Die Jagd." Goethe progressed very slowly with this material and finally discontinued it entirely. Almost thirty years later Goethe completed the tale known only as 'Novelle.'[6] In a conversation with Eckermann Goethe remarks that the development of the action of his 'Novelle' was none other than that of the earlier discontinued epic. The 'Tagebücher' for 1826 shows that it was just at the time that Goethe was reading Cooper that he returned to his old project and carried it to its completion in 1827.

In an admirable monograph,[7] Dr. Sp. Wukadinovic, of the German University of Prague, has shown that Cooper's novels, and especially 'The Pioneers,' have left unmistakable traces in the 'Novelle.' Of Cooper's novels read by Goethe it was only 'The Pioneers' which was carefully read and studied. 'The Last of the Mohicans' and 'The Spy' were read hastily and there is no statement to show that Goethe ever finished reading 'The Pilot.'[8]

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[6] Cf. Bernhard Seuffert. 'Goethe's Novelle.' 'Goethe Jahrbuch.' 19. Bd. s. 133 f.

[7] Goethe's 'Novelle.' Halle a. S. 1909.

[8] The following notices from the "Tagebücher' for 1826 (cited from Wukadinovic) will show how the reading of Cooper and work on the 'Novelle' were carried on together:

Sept. 30. Das Delta von New-Orleans. Fortgesetztes Lesen der Quellen des Susquehanna. Betrachtungen über den Roman überhaupt.

Okt. 1. Den Cooperischen Roman zum zweytenmal angefangen und die Personen ausgeschrieben. Auch das Kunstreiche daran näher betrachtet, geordnet und fortgesetzt.

2. Papiere durchgesucht. Die Quellen von Susquehanna fortgesetzt.

3. Ältere Aufsätze und Schemata gesucht.

4. Erneuertes Schema der wunderbaren Jagd.

8. An der Jagdgeschichte schematisirt. Eine Reinabschrift des Schema dictirt.

9. Die Jagd, theilweise Ausführung.

10. Kleines Gedicht zum Abschluss d. projectirten Novelle.

11. Betrachtung der Novelle.

14. Abends John dictirt an der Novelle.

15. An der Novelle dictirt. Blieb für mich und las den letzten Mohican.

16. Einiges an der Novelle dictirt. Ich las den letzten Mohican hinaus. Schrieb an der Novelle fort.

17. Erster Entwurf der Novelle geschlossen.

18. An der Novelle redigirt.

19. Einiges an der Novelle.

20. An der Novelle redigirt. John mundirte die Novelle.

Wukadinovic then carefully compares 'The Pioneers' and the 'Novelle' with conclusive proof of the influence of Cooper's novel upon the latter in the grouping of the characters, in the treatment of nature, and in the style and content of the somewhat exotic speech of the keeper and his wife. In the same monograph the scene of action in the 'Novelle' is fixed as that of the ruined castle of Hassenstein in Bohemia which Goethe visited while the guest of Prince Lobkowitz in September, 1810.

It is not too much to presume that the memories of his visit to the ruins of Hassenstein, which he was now indirectly weaving into the 'Novelle,' and his recent readings in Cooper suggested the writing of the familiar Xenie 'Den vereinigten Staaten (1827):

Amerika, Du hast es besser
Als unser Kontinent, das alte,
Hast keine verfallene Schlösser
Und keine Basalte. . . .

It may be permitted to mention here a very curious novellette, 'Eine wunderbare Geschichte und ein berühmter Erzähler,' which appeared before the year 1839 as the work of a Mistress Marriet.[9] In this work the aged Goethe is made to appear as guest in the villa of a lady in Treptow near Berlin. There he relates a heart-rending Indian tale à la Cooper which he had experienced upon his youthful wanderings in the forests of North America, in the "Wildernissen des grossen Westens!" When he had ended his narrative, he brushed a tear from his eye, rose, silently took leave of his hostess, and departed.

Stifter.—In a lecture delivered before the International Congress of Art and Science at St. Louis in 1904, August Sauer minutely traced out Cooper's influence on the novelist Adalbert Stifter (1805-1868).[10] Born and reared in the Bohemian forest, remote

[9] Cf. 'Magazin für die Literatur des Auslandes.' 31. Juli, 1839. I have been unable to find any further notice of this work.

[10] 'Ueber den Einfluss der nordamerikanischen Literatur auf die deutsche.' Printed in the 'Jahrbuch der Grillparzer-Gesellschaft.' 16. Jahrg. 1906. For the relations between Cooper and Stifter here considered I am entirely indebted to this article.

21. John schrieb an der Novelle fort.
22. John schrieb an der Novelle fort. Der Spion von Cooper.
23. Spion von Cooper.
24. An dem Roman fortgelesen.
25. Fing an die Geschichte der amerikanischen Revolution von Ramsay zu lesen.

Nov. 4. Fing an den Piloten von Cooper zu lesen.
19. Retouchirte das Jagdstück.
20. Revision der Jagd-Novelle fortgesetzt.

from intercourse, and little affected by the spirit of the times, he early became a close observer and lover of nature and later one of her keenest interpreters. Stifter had always been considered one of the most original of writers. It is therefore of special interest to note that Cooper's works struck a responsive chord in Stifter's nature which was attained frequently in his works.

The poetry of Lenau, who had drawn inspiration from the primitive forests of North America, was familiar to Stifter. Sauer also intimates that Stifter may have been acquainted with the novels of Sealsfield. At least Stifter seems also to have felt a certain "Drang nach Amerika." In a letter he exclaims he should like to leap arm in arm with his future beloved into Niagara Falls. In 'Der Kondor' (one of his Studien) the artist goes across the Atlantic. The preceding action of the 'Feldblumen' is laid in America.

It appears that Stifter has nowhere in his works mentioned Cooper. Sauer, however, assumes that Stifter read all of the 'Leatherstocking Tales' in German, and that Natty Bumpo was a familiar character to him. A comparison is then made between Stifter's 'Hochwald' and Cooper's 'Deerslayer.' The description of the lake in each work is found to resemble the other. The furnishings of the forest home in the 'Hochwald' are not unlike those in the 'Deerslayer.' Old Gregor in the 'Hochwald' and the 'Deerslayer' are both sons of nature. To both a settlement in the virgin forest is, in a sense, a desecration. The 'Deerslayer' says: "Die Wälder sind nie still wenn man ihre Stimme nur zu deuten weiss." Gregor goes in the forest the "Reden des Waldes zu hören und der Sinn ward ihm aufgetan, seine Anzeichen zu verstehen. . . ." Gregor has also taken on some of the characteristics of the 'Deerslayer.' Natty Bumpo liked to lean on his long gun, for which the Indians had named him "la longue haleine." Like Scherr's Groot Willem, Gregor also strikes this stock pose. "Der alte Jäger stand, auf seine Büchse nach vorn gelehnt, wie ein Standbild und keine Fiber an ihm verriet, was in ihm vorgehen könnte. . . ." Like the aged trapper in 'The Prairie,' old Gregor is filled with the recollections of the past. Natty had fled from the haunts of his youth to find at last a lonely grave on the western prairie. Old Gregor is made to disappear in the depths of the forest, like the 'Pathfinder' at the close of the novel of that name. "Einen alten Mann, wei einen Schemen, sah man noch öfter durch den Wald, aber kein Mensch kann eine Zeit sagen, wo er noch ging, und eine, wo er nicht mehr ging."

The greatest similarity, however, exists between the natural descriptions of the two writers. Both look at the forest from a romantic standpoint. Both have a keen sense for its peace and solemnity, for its sacredness and majesty. Each loves to describe it in its minutest details. Stifter had always been awake to the voices of nature, but it was Cooper who loosed his tongue to express them.

It would be out of place to trace out Sauer's investigations in further detail. Let these concluding remarks of Sauer about Stifter suffice: Ein deutscher Dichter von ursprünglicher dichterischer Anlage und wurzelechter Bodenständigkeit berauscht sich in jungen Jahren an exotischen abenteuerlichen Romanen, die eine Woge aus dem fernen Nordamerika in seine Heimat hinübergeworfen hatte und die damals zur verbreitesten Unterhaltungslektüre gehörten. Seine religiöse und künstlerische Entwicklung nimmt dann unabhängig von dem fremden Dichter eine diesem ähnliche Richtung. Als in reiferen Jahren die Quelle der Dichtung plötzlich in ihm aufspringt, sind es neue Werke des alten Freundes, die den Schöpfungsprozess befördern, beschleunigen und in eine bestimmte richtung drängen. . . . Durch Cooper's Eingreifen ist aus einem mittelmässigen Maler ein hervorragender Dichter geworden. Die fremde Wünschelrute zaubert immer neue Schätze aus seiner angestammte Begabung hervor. . . . Fremdes und Eigenes verschmilzt aufs innigste einem neuartigen Dichtwerke, das, wie aus einem Guss, dem innersten Wesen seines Schöpfers entsprungen zu sein scheint und seit jeher als seine eigentümlichste Leistung gegolten hat; ein merkwürdiges und lehrreiches Beispiel für die nahe und fruchtbare Berührung zweier Dichter, zweier Literaturen, zweier Weltteile!

Lewald.—Two of the most prominent novelists of the first half of the nineteenth century were the Countess Hahn-Hahn (1805-1880) and Fanny Lewald (1811-1889). Both had at the beginning of their careers been influenced by the Young German School. The former grew to be an extreme aristocrat in whose estimation only the nobility could furnish characters fit for fiction and in whose works democracy received no place. Fanny Lewald, on the other hand, was democratic in spirit and filled with the ideas of social reform. In her novel 'Diogena' (1847) she has attempted a satire upon her rival, the Countess Hahn-Hahn. This work only interests us here for the delightful travesty the authoress gives us in the third part of the novel of the much-read Indian tale of that period. Diogena is a descendant of the ancient philosopher, whose

race is continued only through female descendants. Upon his deathbed Diogenes gave his only daughter his lantern and his blessing with these additional words: "Suche einen Menschen, bis Du den Rechten findest." All have in turn spent their lives in the search after an ideal man, but with no success. In this novel, Diogena, a woman of a titanic, Faust-like nature, has visited nearly all countries in search for a real man. Finally she also sails to America, but not before thoroughly preparing herself. "Ich las alle Cooper'schen und Sealsfield'schen Romane, um die Sitten der Wilden kennen zu lernen, studirte die Sprache der Delawaren." Dressed as a squaw and with painted body, she proceeds westward with the famous lantern in her left hand.

"Man muss jezt in Amerika lange reisen, ehe man Wilden begegnet; die Welt ist terribel civilisirt, nirgends mehr ein Zug lieblicher Sauvagerie." In the land of the Delawares she meets a superb chief. "Ich hob die brennende Laterne in die Höhe und nahm mein Lorgnon, das ich natürlich nicht zurückgelassenhatte, um ihn zu beobachten. Es war eine Gestalt wie ein jugendlicher Antinous aus rothem Granit." Impressed by his savage, unspoilt grandeur, Diogena follows him, but first returns to her luggage to get her sale volatile and nail brush! Having read in Cooper that Indians respect silence when on the march, she follows the chief silently to his tent. There she speaks to him in the Delaware language and learns he is without a wife. She begs him to take her. Not knowing what love is, the noble chieftain cannot appreciate Diogena's advances. Seeing that this feeble, aristocratic lady cannot even cook his simple meals, nor bring him water, he fears that she will only bear him wretched, cowardly children, and pitilessly sends her back to the Whites, for whom she is good enough. Poor disillusioned Diogena! "Mir schauderte vor dieser unbezwingbaren Rohheit. O, wo blieben meine Hoffnungen! was fand ich in dieser horribeln Realität von den Idealen Cooper's?"

SCHERR.—The well-known literary historian and novelist, Johannes S. Scherr (1817-1886), who in the 'Allgemeine Deutsche Biographie' is termed "eine Persönlichkeit originellster Art, ein Meister des akademischen Vortrages, ein litterarischer Lehrer weitester Kreise, ein vorragender Kämpfer für Freiheit, Vaterland, Bildung, und ein Sprachbildner und Sprachgewaltiger, wie kaum ein zweiter unter den Sprach- und Zeitgenossen," wrote a novel in 1853 which cannot fail to be of interest to the student of Cooper. In 'Die Pilger der Wildnis' the author chose

the same material which Cooper employed in his 'Wept of Wish-ton-Wish' (1829), namely the great struggle between the Puritains of Connecticut and the Indians under Metacom, commonly known as King Philip's War. But Scherr is by no means a mere imitator of Cooper. In his hands the same theme receives widely different treatment. As might be expected of the well-known writer of the 'Bildersaal der Weltlitteratur' (1848), the 'Geschichte der englischen Litteratur' (1854), and the 'Allgemeine Geschichte der Litteratur von den ältesten Zeiten bis auf die Gegenwart' (1851), Scherr has carefully studied the historical background of this work and has woven a considerable amount of early colonial history into the story. Roger Williams, the colonial apostle of religious liberty, and the sturdy warrior Miles Standish themselves enter into the novel. The work gives evidence of the author's wide acquaintance with American letters. He had studied the work of George Katlin on the American Indian. Also Bradford, Allston, Hemans, Talvj, Irving (whom he calls the greatest writer America has produced), Halleck and Follenius are mentioned.

Though 'Die Pilger der Wildnis' is far from being an imitation of Cooper's 'Wept of Wish-ton-Wish,' it nevertheless bears abundant evidence of the influence of Cooper. To the reader of the 'Leatherstocking Tales' there is something very familiar in the following lines: Er war von fast riesenmässigem Wuchse und stand, um einen Ausdruck des Landes zu gebrauchen, in welchem unsere Geschichte spielt, weit über sechs Fuss hoch in seinen Schuen oder veilmehr Mokasins (indianischen Schuhen), an welche sich Kamaschen von Hirschhaut anschlossen, die bis über die Knie hinaufreichten. Er trug ein Koller von Büffelhaut, und ein Mantel vom nämlichen Stoffe lag zu seinen Füssen. Auf dem Kopfe hatte er eine Mütze von Wolfsfell, um die Lenden einen roh gearbeiteten Gurt von Otternpelz, an welchem Pulverhorn und Kugelbeutel hingen. . . . Die Büchse, welche er an einem Lederstrick auf dem Rücken trug, entsprach an Grösse und Schwere der Gestalt ihres Eigentümers, denn man würde sie heutzutage füglich ein Standrohr nennen." This is part of the description of the old Dutch trapper, Groot Willem, one of the "Vorläufer und Wegbahner europäischer Kultur" in the new world. It is not difficult to recognize that he is a descendant of Leatherstocking. Like Natty Bumpo he had in his long intercourse with the Indians also taken on something of their character and their laconicism. Occasionally, too, Groot Willem assumes Natty's

characteristic pose, in which he stands leaning himself, statue-like, upon the barrel of his long gun. The old trapper also expresses that sympathy for the dying Indian race, in which Leather-stocking sometimes indulges. Natty's love of nature and his lament over the fate of the primeval American forests receding under the axe of the pioneer are again re-echoed in Groot Willem.[11] Willem also flees from encroaching civilization. Like Natty, he lives to an extreme old age. Natty died on the prairie. Groot Willem crossed the Alleghanies and was one of the first to enter the Valley of the Ohio. Moving westward as the frontier moved, he finally died in the virgin forests he loved so well.

Such stock Cooperian terms as "Alter Waldteufel," "Waldgänger," "Alter Trapper," "Alter Waldläufer," and "Grosse Medizin," are scattered throughout the book.

It is very probable too, that Scherr had read the works of other writers of Indian fiction. The author has inserted a variation of John Smith's rescue by Pocahontas in 'Die Pilger der Wildnis.' Thorkil, the adopted son of the old trapper, Willem is about to receive the fatal stroke when Hih-lah-dih, Chief Metacom's sister, rushes to him and throws her arms about his neck. Curiously enough, Miss Sedgwick's novel 'Hope Leslie,' which has a great resemblance to the 'Wept of Wish-ton-Wish,' though it appeared two years earlier than Cooper's tale, also contains a form of the Pocahontas story. Interesting, too, is the fact that at the close of 'Die Pilger der Wildnis' Scherr cites in German the same passage from Jefferson with which Sealsfield introduced his Indian novel 'Der Legitime und die Republikaner' (1833).[12]

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[11] 'Der alte Trapper kehrte sich bei diesem Zuruf um und erwartete, auf sein Roer gestützt, das Herankommen De Lussans.' Book 4, p. 5.

'Groot Willem und der Filibustier hielten sich ein paar Schritte abseits von den übrigen, jener nach seiner Gewohnheit sinnend auf den Lauf seines Roers sich stützend.' Book 4, p. 203.

' . . . ihr ahnt nicht, dass ein schreckliches Los über eurem Volke schwebt, dass sein Untergang beschlossen und besiegelt ist. . . . Dann wird es hier herum auch aus sein mit dem freien schönen Waldleben.' Book 4, p. 115 f.

'Ich vermute, Sir, Rote und Weisse hätten in diesen unermesslichen Länderstrichen ganz gut nebeneinander Platz gehabt, wenn sie sich ehrlich und gerecht miteinander hätten vertragen wollen' Book 4, p. 211.

'Ach . . . es wird, fürcht' ich, eine Zeit kommen, und sie mag nicht mehr so fern sein, wo all diese Waldherrlichkeit dem unersättlichen Beile der Kolonisten zum Opfer fallen wird. Aber ich danke meinem Schöpfer, dass meine Augen den Greuel der Verwüstung nicht mehr werden mitansehen müssen, dass ich schon lange unter dem Rasen liegen werde, wann die Verheerung von der Seeküste her allwärts tiefer ins Land vorschreiten wird." Book 4, p. 10.

[12] Sealsfield's rendition: 'Ich zittere für mein Volk, wenn ich der Ungerechtigkeiten gedenke, deren es sich gegen die Ureinwohner schuldig gemacht hat.'

Scherr's rendition: 'Ich zittere für mein Volk, wenn ich den Ungerechtigkeiten nachsinne, deren es sich gegen die Eingeborenen schuldig gemacht hat.'

The Cooperian influence upon the authors mentioned above is after all only sporadic. Not one of these authors was a disciple of Cooper in the sense that Hauff and Alexis were of Scott. For such followers we must turn to the exotic school of novelists, many of whom identified themselves exclusively with the transatlantic novel. These writers were nearly all men whom conditions at home or pure "Auswanderungslust" had brought to the shores of America. Some had lived as squatters or planters in the far West; others had even dwelt among the Indians. All were in a sense adventurers, and with few exceptions only later turned to novel-writing. In some instances they diverge far from the path of Cooper. Since Cooper's early novels the Far West had been opened, and different conditions, both among the Indians and the frontiersmen, presented themselves to the novelist. The novel itself had evolved decidedly toward realism. In spite of all this, Cooper's novels nevertheless remained a factor and their traces cannot be ignored in the younger writers. The most prominent of these writers were Sealsfield, Strubberg, and Möllhausen.

Sealsfield.—Charles Sealsfield (1793-1864), commonly known as the father of the exotic novel, was the first to write an Indian novel in German after the manner of Cooper. Monastic life in Prague was too restraining for the impetuous young Austrian monk Carl Postl. He fled to America and was henceforth known to the world as Charles Sealsfield. In America he lived a varied life as traveller, correspondent, and editor. In 1828 Sealsfield's first novel, 'Tokeah or the White Rose, an Indian Tale,' appeared in English. It was published by Carey and Lea of Philadelphia, who two years before had published Cooper's 'Last of the Mohicans.' This novel was later rewritten and appeared in German in 1833, as 'Der Legitime und die Republikaner.' The great French Romanticist Chateaubriand had conceived beautiful poetic Indians in his 'Atala.' The white man, when compared with these exalted beings living in a lovely primitive world suffers by such comparison and rather deserves our pity. However, in Cooper's works we are made to pity the Indian and feel that his fate has been unjustly sealed by the Whites. The elegiac note of the 'Last of the Mohicans' is plainly re-echoed in Sealsfield's 'Legitime und die Republikaner.' The novel is introduced with the memorable words of Jefferson: "Ich zittere für mein Volk, wenn ich der Ungerechtigkeiten gedenke, deren es sich gegen die Ureinwohner schuldig gemacht hat." The author evidently desired to depict

in this novel the last struggles of the legitimate heirs to the American soil against the white intruders. In this historical novel we witness the wars of some tribes of the Creeks, whose former lands lay in Georgia and Alabama, under their chief, Tokeah, against the Whites under the great republican General Jackson. Tokeah finally gives up the land of his ancestors and leaves to find a new home among the Comanches in the Far West. Tokeah dies while still east of the Mississippi, but his remains are brought to the land beyond the great river, where he had hoped to live unmolested with his people. The Indian chief Tokeah is in some respects not unlike Cooper's Chingachgook. Like Natty in 'The Prairie,' which had appeared a year earlier than 'Der Legitime,' Tokeah also retires westward before the coming wave of eastern civilization. The general atmosphere in Sealsfield's novel is more Cooperian than that of his subsequent works.[13] In spite of this conventionality, Sealsfield's work received high praise. It demanded some courage for a German to strive for a place beside Cooper. A contemporary critic writes: "Hätte Cooper's gebildetere Feder diesen Plan ausgeführt, so dürfte die Ausführung mancherlei gewonnen haben. Im ganzen aber müssen wir, Cooper's Talent in Ehren, dieser Conception vor der Cooper'schen den Vorzug geben, weil sie geistreicher und grossartiger ist. Auf jeden Fall ist dieser Roman bei weitem lehrreicher als irgend ein Scott'scher oder Cooper'scher, und verdient von den Deutschen besonders beachtet zu werden, die schon mit einem Fusse aus ihrer heimatlichen Hütte getreten sind, um die grosse Auswanderung zu gewinnen."[14]

In the unfolding of a plot Sealsfield was never so successful as Cooper. He felt this and confined himself largely to the shorter form of narrative. From 1834 to 1837 appeared his 'Lebensbilder aus der westlichen Hemisphäre,' a series of sketches in six volumes. In the sixth volume we have the striking story of 'Nathan Strong, der Squatter-Regulator.' Nathan is one of Sealsfield's best character portrayals. The reader of Nathan will, however, have no difficulty in recognizing that Nathan is none other than our old friend Natty Bumpo seen through the rugged, virulent temperament of Sealsfield. The following description may serve to show Sealsfield's manner of treatment: "Also Nathan hier! diese in

[13] Cf. Sarrazin's criticism of Faust's 'Charles Sealsfield. der Dichter beider Hemisphären,' in the 'Archiv für das Studium der neueren Sprachen und Litteraturen.' 100. Bd. s. 398-401.

[14] See 'Blätter für literarische Unterhaltung.' Lpz. 7. März, 1832.

den Squatter-Annalen Epoche machende Person! Das ist ja ein förmlicher Roman! Aber der Mann ist wichtig, und hat zu Etwas den Grund gelegt, das——. Doch wir wollen den Squatter-Helden näher beschauen. Er ist's auf alle Fälle werth. Eine Ehrfurcht gebietende Gestalt, an der wenigstens achtzig Jahre vorüber gegangen sind, wahre Riesentrümmer; die Züge stark hervortretend, massiv, beinahe grandios, antik; die Stirne, Wangen wie mit Eisenrost und Moos überzogen, aber nicht abgelebt, nicht widerlich, im Gegentheile, man sieht mit einer Art Ehrfurcht in dieses bemooste, wie rostige Antlitz'' (p. 420). . . . And again: ''Unter ihnen ragt der alte Nathan wie eine tausend-jährige Lebenseiche, oder ein gothischer Dom, über die ihn umgebende Pflanzen—oder Häuserwelt empor, ein ehrwürdiges Bild unverwüstlicher Kraft, unbezwingbarer Ausdauer. Er sticht in seinem Lederwamse, Inexpressibles und Linseywoolsey-Rocke so grell gegen die eleganten Fashionables, und die allerliebst um ihn herum trippelnden und schwebenden Dämchen ab'' (p. 440).

Sealsfield appears to have been well acquainted with Cooper's novels. Occasionally we can not help but feel that Sealsfield was conscious of his relations to Cooper and that he made special efforts to conceal them by antagonizing the latter. It was certainly not very fitting for Sealsfield to accuse Cooper of never having seen a real trapper,[15] when we have no reason to think that Sealsfield ever had direct acquaintance with the Indians which he nevertheless ventures to employ.

Strubberg.—One of the most interesting figures in this group of writers was that of Friedrich Armand Strubberg (1806-1889) who, in company with several other Germans, lived a number of adventurous years in a palisaded fortress on the extreme frontier of Texas. Returning to Germany he wrote upwards of sixty volumes of fiction in most of which frontier and Indian life afford the chief themes. Unfortunately Strubberg had none of Cooper's art to create and carry out a finely motivated plot. He was a very close observer, however, and his novels are valuable for their great wealth of detail. Though he saw with the eyes of a realist he was not consistent in his realism. Many of his Indians are splendidly realistic portraits of the redskin of the

[15] 'Es ist etwas Eigenes in diesen endlosen Wiesenwüsten, das den Geist erhebt, ihn, wir möchten sagen, nervig und stark macht, so wie den Körper. Das herrschet das wilde Ross und der Bison und der Wolf und der Bär, und Schlangen zahllos, und der Trapper, alle an Wildheit übertreffend—nicht der alte Trapper Cooper's der in seinem Leben keinen Trapper gesehen, aber der wirkliche Trapper, der Stoff zu Romanen geben könnte, die den pinselhaftesten Pinsel begeistern müssten.' (P. 134, Part V of 'George Howard's, Esq., und Ralph Doughby's, Esq., Brautfahrt.')

Far West in the middle of the nineteenth century. But among these, and in terms of greatest intimacy with them, we meet also the romantic Indians of Cooper and of Chateaubriand. The Indian maid Owaja in 'An der Indianergreuze' (1859); Utho and his bride Zateka in 'Der Sprung vom Niagarafalle' (1864); Kionata in 'Leonide,' one of the novelettes in 'Aus Armand's Frontierleben (1867); and the Indian brave Paneo in 'Ein Wilder,' a novelette in the same work, are all characters which strongly suggest to the reader the Cooperian Indian. They were apparently introduced for the sake of the romantic story. The majority of Strubberg's Indians, it must be said, are of genuine flesh and blood. We may say that Strubberg aimed at giving a truthful portrayal of the Indian even to the extent of sacrificing good taste. Just as the Indians were "varmint" to Natty Bumpo, they were also, as a class, in Strubberg's estimation, only "Lumpe."

Since the appearance of Cooper's 'Last of the Mohicans,' the melancholy idea of the death of the last member of a dying race has been a favorite subject for treatment. This idea is also evident in Strubberg's 'Ralph Norwood' (1860), whose theme, not unlike that of Sealsfield's 'Der Legitime und die Republikaner,' is the struggle of the Seminoles in the South against the Whites, and the final removal of the remnant of that once mighty race to the West. Tallihadjo, the chief, speaking of the brewing difficulties with the Whites, says: "Wenn die Zeit aber gekommen sein wird wo das kleine Stück Land, welches Euch die Weissen noch gelassen, Euch nicht mehr ernähren kann, wenn Eure Heerden verkümmern und Ihr zu sterben bereit seid, dann ruft Tallihadjo, damit er Euch zur Schlacht führe; *denn glaubt mir, es wird der letzte Kampf des letzten Indianers in Florida werden*" (Vol. 1, p. 114). Later the chief says: "Vereinigt hätte unser Volk die weisse Brut in Florida erdrückt . . . uneinig aber, wie wir sind, wird ein Stamm nach dem andern fallen, *bis das Herz des letzten Seminolen aufgehört hat zu schlagen*" (Vol. III, p. 219). In the same novel Eleanor, her husband, Frank Arnold, and her father, Forney, visit Trenton Falls in New York, and there meet a solitary Indian, of whom we read: "Der Führer theilte ihnen mit, dass dieser Mann *der letzte Häuptling* des noch vor nicht vielen Jahren so mächtigen Volks der Oneidas sei. . . . (Vol. IV, p. 132).

'Carl Scharnhort, Abenteuer eines deutschen Knaben in Amerika' (1863), is an interesting story of German emigration to America. The German lad, Carl Scharnhort, develops into a

wonderful huntsman among the Indians in the West, a sort of youthful Leatherstocking. In the same novel, Daniel, the negro, receives the name of "Spürer" from the Indians for his skill in taking up trails, an epithet which suggests the English "Pathfinder."

In Strubberg's 'Alte und neue Heimat' (1859) is a passage which bears testimony to Cooper's popularity in Germany and his influence upon certain of his readers. The author describes the arrival of German emigrants in Galveston, Texas: "Man erblickte purpurfarbene und rothe, mit Schnüren reich besetzte Paletots, spanische Überwürfe mit aufgeschlitzten, weiten Ärmeln, italienische Anzüge nach Rinaldo Rinaldini und Masaniello, *Lederanzüge nach Natti aus Cooper's Letzten der Mohikaner,* Strumpfmützen, mittelalterliche Reiterhüte mit aufgekrämpten breiten Rändern und mit Federn, spitze graue Filzkappen, wie sie die Narren auf deutschen Maskeraden zu tragen pflegten und Stiefel-Façons aus allen Jahrhunderten, in denen solche getragen wurden." This is a picture, though probably exaggerated, of a certain class of German youths, who, like the poet Lenau, were attracted to America out of love for romance and adventure.

Möllhausen.—Of those German novelists who have identified themselves with America none more deserves to be called the German Cooper than Balduin Möllhausen (1825-1905). His great command over American material, his skill in the portrayal of character, and his ability in the handling of a plot give him the most prominent place among the writers of transatlantic fiction. Like Cooper, too, he wrote a number of excellent sea novels, which give him an enviable place among the German writers of this species of fiction. Möllhausen had come to America about 1849, and early in 1850 joined the expedition of Duke Paul of Würtemberg to the Rocky Mountains. He returned to Germany in 1852. In April, 1853, he again sailed to America and there received a position as topographer in a government expedition conducted by Lieutenant Whipple for the purpose of investigating the nearest route for a railroad to the Pacific. Möllhausen returned to Germany in 1854. In 1857 he was again on his way to America, now as assistant to an expedition sent by the United States Government under Lieutenant Ives to explore and survey the Colorado River. From this expedition he returned to Germany in 1858. On these various journeys Möllhausen had enjoyed an excellent opportunity to study life in America, especially

that of the pioneer and the Indian in the Far West, and he used his observations to good advantage. From the time of the appearance of his first work 'Tagebuch einer Reise vom Mississippi nach den Küsten der Sudsee' (1858) to his death in 1905 he published more than 150 volumes of fiction, nearly all of which deals with America, and much of which portrays life among the Indians.

Möllhausen was born a year after the first German translation of any novel of Cooper; his boyhood was passed during the period of Cooper's greatest popularity in Germany; he had himself been an eye-witness of border life, and had seen the American frontier as it receded to the Pacific; he had lived to see the popularity of Cooper wane after three quarters of a century; and he himself was the last exponent of Cooperian fiction in Germany.

Möllhausen had had opportunities for seeing western America as possibly no other German writer, and but few American writers had enjoyed in those early days. But Möllhausen, like Cooper, saw the world with the eyes of a romanticist. This did not prevent the author from giving adequate portrayals of the rougher elements of Western life, though we can recognize an endeavor to subordinate such matter. He followed no new paths in fiction. Of an artistic temperament, to which his many beautiful water-colors and oils testify, he tried to bring his subject-matter within the confines of literary form. From a purely literary standpoint, therefore, his novels surpass those of Sealsfield and Strubberg, though cast in an established form. In the lightness and variety of his character-sketching and in his humor he often suggests Dickens. Though Möllhausen was by no means lacking in originality, there is nevertheless sufficient evidence in his works to testify to the stimulating force of Cooper's novels. Of these, 'The Last of the Mohicans' has probably left most abundant traces in the works of his followers. In 'Wildes Blut' (1886) are the following "Nachklänge": The medicine man says of himself: "Towaka Koti lebt noch. Nie freite er um ein Kaskaskia-Mädchen. Paart der Fuchs sich mit dem Eichhorn? Nein. Towaka Koti ist der Letzte seiner Familie." Later the old Indian woman says: "Die Haniks sind verschwunden. Ich bin die letzte Hanick Wisah; denn mein Sohn Wiskun wird vor mir sterben." In 'Die Söldlinge' (1892) Möllhausen has employed the interesting material of the city builders in New Mexico, and the relations of the Zunis with the Azteks and Tolteks. In this work

the fate of the aged Zuni Ahuitzotl, last king of Anahuac, the last of the Azteks, in his grotto in the Casas Grandes, also harks back to 'The Last of the Mohicans.'

Möllhausen's novels contain many bits of splendid realism. However, many of his prominent characters are purely romantic in nature, and frequently enough suggest the Cooperian character. Such are the half-breed Indian maid Coralle, the foster-daughter of Miss Lonesome, the proprietress of a frontier store in Missouri in the novel 'Die Einsiedlerinnen' (1873); Lilac, the Indian girl who dies of unrequited love in 'Die Töchter des Konsuls' (1880); the white child Charitas in 'Der Leuchtturm am Michigan' (1883); and Taito, the stolen white child adopted by the Kioways in 'Die Trader' (1884). Some of these characters also bear strong traces of Rousseauism.

In the story 'Der Hornfrosch in Reliquien' (1865) Möllhausen seems to aim at a realistic effect by placing a Cooperian Indian in contrast. In this story is Oglala, an Indian warrior, who "durch seine äussere Erscheinung nicht wenig an die romantischen Gestalten Cooper's erinnerte."

In 'Der Talisman' (1894) Jurassic, the daughter of the naturalist Bloomfield, a breezy Amazon-like maid, is kidnapped and held for ransom by some Western ruffians in complot with the Indians, an episode which may have been suggested by the kidnapping of Laura in 'The Last of the Mohicans.'

Cooper's Natty Bumpo, one of the most original creations in American fiction, is a character which few writers of Indian tales have been able to resist. The trapper or guide of Western America is a favorite character with Möllhausen, and appears again and again in his works. In 'Der Halbindianer (1861) appears the fine old trapper and guide Lefèvre with his characteristic expressions "mile tonnere," "sacre tonnerre," and "sapristi." One of the best characters in 'Der Majordomo' (1863) is the old backwoodsman and trapper Gale, who lives in the Tulare Valley and cannot tell a book from a hoe-cake. In 'Der Talisman' (1894) we meet the old guide Vilanderie, "Fallensteller und Fährtensucher" (elsewhere the usual translation for "Pathfinder" is "Pfadfinder"). In the same novel is introduced the Canadian trapper Laboux. He is described as follows: "Er war ein langer, hagerer Mann, von dem man hätte behaupten mögen, dass die von der Prärie hereinwehende Luft eine ähnliche Wirkung auf ihn ausübte, wie auf einen gefallenen Büffel, der von den Wölfen verschont geblieben, allmählich zu einer Mumie ausdörrt. Mit

seinem listigen Waschbärengesicht, auf dem nur wenige dürftige Bartproben sichtbar waren, stand im Einklang eine eigentümliche Wortkargheit, ohne dass ihm deshalb Menschenfeindlichkeit oder Mangel an Gastfreundschaft hätte zum Vorwurf gemacht werden dürfen.'' In 'Das Fegefeuer in Frappes Wigwam (1900) figures the well-known French guide Vilandrie (probably identical with Vilanderie in 'Der Talisman'). In all these characters the reader will easily recognize something familiar. They possess, to a greater or less extent, the characteristics of their famous prototype, the Leatherstocking. Möllhausen was, however, by no means a slavish imitator. It may even be unjust to say that Cooper's Leatherstocking has served as a model for the above-mentioned characters. The trapper is one of those figures which cannot be disassociated from frontier life. As one of the most picturesque characters of early American civilization he was bound to find his way into fiction sooner or later.

The interest Möllhausen possessed in Cooper is manifested in a passage from his 'Tagebuch einer Reise vom Mississippi nach der Südsee' (1858), in which he speaks of his travels with the Ottoe Indians during his first stay in America. He writes: ''I learned to look with pride on my ragged mocassins and scarred feet, and to laugh at the icy north wind blowing on my naked breast. . . . I felt in the most joyous spirits, and seemed to be realizing the dreams of my youth (dreams conjured up certainly by Cooper and Washington Irving), when I sent a bullet through the skull of a bear, or gave some mighty stag the *coup de grace.''*

The taste for Indian fiction which Cooper's works had created in Germany was not easily satisfied. It was not long before the works of J. K. Paulding, F. Marryat, Dr. Robert Bird, W. G. Simms, Sir Charles Murray, Captain Mayne Reid and many less-known writers were also translated into German and found many eager readers. Parallel to this current of translations from the above English and American writers flowed another from French sources. In France Cooper's works had also called forth a group of Indian writers whose works were in turn also translated into German. Gabriel Ferry (pseudonym for Louis de Bellemarre), Paul Duplessis and Gustave Aimard became well-known names in German fiction. Among other German writers of Indian fiction, the best known are Friedrich Gerstäcker, Ernst Freiherr von Bibra, Friedrich Pajeken and Karl May. These with many others have received consideration in

my article 'The American Indian in German Fiction.' It would be difficult and perhaps useless to investigate this vast mass of Indian fiction with the purpose of discovering in it any direct influence of Cooper's works. But whether these German writers received inspiration directly from the novels of Cooper or indirectly through the medium of such American, English or French works as were themselves inspired by Cooper, the fact nevertheless remains that it was Cooper's novels which stimulated and in many instances furnished the immediate impetus for the production of this great mass of Indian literature.

III. COOPER'S TRAVELS IN GERMANY

Unlike Cooper's first literary endeavor 'Precaution' (1820), which was a failure, his second novel 'The Spy' (1821) was immediately received with success. In a few months it had enjoyed a sale greater than any other American novel. Early in 1822 the novel was published in England. In the summer of 1822 it appeared in French. In 1824 it was translated into German. It was this novel which assured Cooper's success on the Continent. 'The Pioneers' (1823) and 'The Pilot' (1824) were also immediately translated and only served to increase his popularity. With the appearance of 'The Last of the Mohicans' (1826) Cooper was at the very height of his fame. These successes made it financially possible for him to realize an old desire to visit the countries of Europe. After having first been appointed consul at Lyons by Secretary of State Henry Clay, Cooper sailed for Europe with his family in June, 1826. An outline of his travels, according to Lounsbury, follows: After a short stay in England, Cooper went to France where he arrived July 18, 1826. He remained in or about Paris until February, 1828, when he returned to England. In June he returned to France by way of Holland and Belgium. In July, 1828, he settled in Berne, Switzerland. In October he crossed the Simplon Pass and stayed in or near Florence during the following winter and spring. Having given up his position as consul he remained in Rome during the winter of 1829-30. In the spring of 1830 he went to Venice and thence across the Tyrolese Alps to Munich. Later in the year he settled in Dresden. At the outbreak of the July Revolution he hastened to Paris, where he remained until his return to America in November, 1833.

We are only interested here in his travels in Germany for which the best authority is his own account as given in his 'Sketches of Switzerland.' By an American. They appeared in two parts of two volumes each in 1836. The title of the English Edition of Part One was 'Excursions in Switzerland;' of Part Two 'A Residence in France; with an Excursion up the Rhine, and a Second Visit to Switzerland.'

In the first part of these Sketches he tells of his excursion from Paris through Burgundy to Berne, Switzerland, in 1828. He shows himself a student of Swiss history and an appreciative observer of Alpine scenery. From Berne he journeyed to the

Bernese Oberland and to Thun; also he passed through a part of the canton of Zurich and came to a spot where "three posts marked the contiguity of Baden, Zurich and Schaffhausen." In this vicinity he caught glimpses of a "fortress on a high rock, called Hohentwiel, in Wurtemburg," which Scheffel was later to celebrate in his 'Ekkehard.'

Cooper's knowledge of German seems, at least at this time, to have been very limited. On the way to St. Gallen, he notes, p. 152: "Beggars had been a blot on the scenery for the last day or two; . . . we had paused to rest ourselves, on the side of this mountain, when two or three children came scrambling from a cottage, on the usual errand. The oldest was scarcely two years old. The last was an infant of rare beauty; fair, with the eyes of an angel, and perfectly golden hair. . . . The little cherub plaintively lisped, as she approached, as near as we could understand, 'pity, pity.' " In a foot note Cooper explains: "Greater acquaintance with the German has since shown me that the little thing merely uttered the common entreaty of "bitte, bitte,' or 'pray do.' " However, in the same volume the novelist speaks of studying the reports of one or two German writers who had traveled in the United States, from which we infer that the novelist had made rapid progress.

In Volume II we follow Cooper to Lake Luzerne, where he visits the Tell country. Also he stops at Glaris, mentions its cheese, the celebrated Schrabzieher, and conjectures the derivation of its name.[16] He next follows the Upper Rhine and explores the Grimsel, Furca, and St. Gotthard passes. Having returned again to Berne, he set out for Italy by way of the Simplon Pass. The second volume closes with his arrival in Milan.

More than half of the third volume is taken up with his experiences in Paris. In the latter part we find Cooper and his family on their way to Belgium in an old calêche which had been enlarged to accommodate two servants, one of whom was a Saxon girl hired in Germany. From Brussels they journeyed by way of Louvain, Liege, and Spa, to Aix-la-Chapelle (Aachen). This trip took place in 1832. He comments upon the ancient cathedral, Charlemagne's chair, and the painted glass. At Berghem,

[16] 'The name, so far as my knowledge extends is compounded of 'Ziegen' (goats) and some local word that means either plant, or the name of a plant. The latter, however, is purely conjecture. 'Busch' is shrub, in German, but 'schrab' sounds so near it, that I dare say it is some obsolete word of the same signification, although it is no more than fair to repeat to you that this is sheer conjecture.' (Vol. II, p. 47.)

a few stations beyond Aachen, he is visited by the postmaster and his clerk, the latter asking him if he were the man who wrote books! He is impressed with the homage Germans pay men of letters, and in this connection relates an interesting incident concerning the poet Tieck, which came to his notice while in Dresden.[17]

The party advances to the borders of the Rhine and finally enters Cologne. After the fashion of a modern tourist, Cooper visits the cathedral, the house in which Rubens was born, and the relics of the eleven thousand virgins. Also he buys some Cologne water. The city itself he finds "the dirtiest and most offensive we have yet seen, or rather smelled in Europe." The novelist continues up the Rhine, speaks of the Drachenfels, relates the legend of Nonnenwerth, and lodged for the night in the former convent which had been converted into an inn. Here he experienced the unique feeling of being called "Herr Graf!" The party loitered much on the way to examine the ruined castles. A minute description of the Rheinstein, called the Ritterstein by Cooper, is given. Also he gives an account of the halt at Rüdesheim, where he tried a bottle of "Hinterhausen" to his dinner and immediately became a convert to it. But he remarks, "one cannot drink a gallon of it with impunity." He discourses at length upon the qualities of the wines of this celebrated region. He regrets not to find any traces of the ruins of Charlemagne's castle at Ingelheim and exclaims: "Such is the difference between the false and the true Roman!" From Biberich the journey continued to Wiesbaden, and thence to Frankfort on the Main. Much of this ground Cooper seems to have covered the year before when he sojourned for a longer time in Dresden, and his accounts are therefore frequently somewhat brief. In Heidelberg the novelist revisits the castle, but has grown more critical.

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[17] Cooper's sketches being difficult of access, it may be permitted to quote this incident at length: 'We had lodgings in a house directly opposite the one inhabited by Tieck, the celebrated novelist and dramatist. Having no proper means of introduction to this gentleman, and unwilling to obtrude myself anywhere, I never made his acquaintance, but it was impossible not to know, in so small a town, where so great a celebrity lived. Next door to us was a Swiss confectioner, with whom I occasionally took an ice. One day a young man entered for a similar purpose, and left the room with myself. At the door he inquired if I could tell him in which of the neighboring hotels M. Tieck resided. I showed him the house and paused a moment to watch his manner, which was entirely free from pretension, but which preserved an indescribable expression of reverence. 'Was it possible to get a glimpse of the person of M. Tieck?' 'I feared not; some one had told me that he was going to a watering-place.' 'Could I tell him which was the window of his room?' This I was able to do, as he had been pointed out to me at it a few days before. I left him gazing at the window, and it was near an hour before this quiet exhibition of heartfelt homage ceased by the departure of the young man.' (Vol. 2 of Part Second, p. 199 f.)

and pronounces the ruins "vast, rather than fine." The journey continued up the Neckar to Ludwigsberg. While standing on a balcony of the palace of the Princes of Wurtemberg, the guide pointed out the little hamlet of Marbach, the birthplace of Schiller. Cooper seems to have been an admirer of the great poet. He writes (Vol. II, p. 25 of First Ed., Part Second): "Few men can feel less of the interest that so commonly attaches to the habits, habitations and personal appearance of celebrated men, than myself. The mere sight of a celebrity never creates any sensation. Yet I do not remember a stronger conviction of the superiority enjoyed by true over factitious greatness, than that which flashed on my mind, when I was told this fact. That sequestered hamlet rose in a moment to an importance that all the appliances and *souvenirs* of royalty could not give to the palace of Ludwigsberg. Poor Schiller! In my eyes he is the German genius of the age. Goethe has got around him one of those factitious reputations that depend as much on gossip and tea drinking as on a high order of genius; and he is fortunate in being a *coddled celebrity*—for you must know there is a fashion in this thing, that is quite independent of merit—while Schiller's fame rests solely on its naked merits. My life for it, that it lasts the longest, and will burn brightest in the end. The schools, and a prevalent taste and the caprice of fashion can make Goethes in dozens, at any time; but God only creates such men as Schiller."

From Ludwigsburg the party went to Stuttgart. At the inn Cooper learned with regret that Sir Walter Scott had passed but two days before. Beyond Tübingen they saw the ruined castle of the Hohenzollern, and then continued to Schaffhausen by way of Tuttlingen. Finally they find themselves again in Switzerland and seem to be much pleased when they arrive in Zurich. It so happened that Cooper's great forerunner in Indian fiction, Chateaubriand, was in Zurich at the same time. Unfortunately, the two great writers were destined not to meet. Concerning this instance Cooper says (p. 40): "M. de Chateaubriand is in the same hotel as ourselves, but it has never been my fortune to see this distinguished writer to know him, even accidentally; although I afterwards learned that, on one occasion, I had sat for two hours on a bench immediately before him, at a meeting of the French Academy. My luck was no better now, for he went away unseen, an hour after we arrived."

When Cooper went to Europe in June, 1826, he took with him an unfinished novel. It was finished in Paris and published

as 'The Prairie' in May, 1827. Cooper's popularity in Europe made it possible for five editions of this novel to appear simultaneously, one of which appeared in Berlin. 'The Water-Witch' was written in Italy. It was Cooper's intention to have it published in Rome, but the censor found Cooper's Americanism too assertive and asked the author to alter the manuscript. Cooper in consequence took it with him to Germany and had it published in Dresden. 'The Water-Witch' was for some time the last novel to deal with America. During the remainder of his stay in Europe he turned to other fields for his material and with no great success. We have mentioned Cooper's hasty return from Dresden to Paris upon the outbreak of the July Revolution in 1833. His interest in European politics led him to write three novels, each of which has Europe for its scene of action. Lounsbury has pointed out that the weakness in these novels lay, not in the fact that Cooper was dealing with foreign material, but that he was writing with the purpose of enforcing political opinions. They are 'The Bravo' (1831), 'The Heidenmauer' (1832), and 'The Headsman' (1833). Only the second interests us here.

The subject for 'The Heidenmauer' was suggested to Cooper upon his journey in the valley of the Rhine. In the introduction to the third volume of his 'Sketches in Switzerland' (1836), he gives the time of the trip as 1832, but intimates several times in the course of the Sketches that he had previously made a Rhine journey. However, the outline of the journey as given in the Introduction to 'The Heidenmauer' is almost identical with that in the Sketches. In the Sketches the journey is continued from Heidelberg to Stuttgart, and then through a part of the Black Forest to Zurich. In the Introduction to 'The Heidenmauer' the party of four drive in a light calêche from Heidelberg to Mannheim. Thence it is their intention to travel on by way of Kaiserslautern and the great Napoleon road to Paris. They had already crossed the plain of the Palatinate when the illness of one of the party caused them to halt in the town of Duerckheim which had once been the residence of the Princes of Leiningen. The party lodged at the sign of the Ox. On asking his host about the ruins on the near mountains, the novelist was informed they were those of the Abbey of Limburg and of the castle of Hartenburg. "What! a ruined abbey, and a ruined castle, too! Here is sufficient occupation for the rest of the day. An abbey and a castle!" "And the Heidenmauer, and the Teufelstein." "How! a Pagan's Wall, and a Devil's Stone! You are rich in curiosi-

ties!" Together with the village tailor who knew some French, Cooper's German being, as he informed the host, far from classical, they set out to visit the places of interest. After seeing the ruins of the abbey and the castle, Cooper sought information about the Pagan Wall. The "Heidenmauer" was supposed to be the spot where Attila had camped during the winter before he crossed the Rhine and marched against the Romans. The wall was, however, supposed to be the work of the Romans themselves. The Devil's Stone nearby was a natural rock upon which sacrifices were thought to have been made. These objects of interest and the legends told him in the inn at Duerckheim furnished Cooper with material for the novel. "The following pages," he wrote, "are the offspring of the convocation held in the parlor of the Ox." 'The Heidenmauer' has little to remind us of the author of the 'Last of the Mohicans;' in fact it is one of the least readable of Cooper's novels. It is a tale of the period of the Reformation and has for its theme the schism between the barons and the church, with special reference to the disputes between the communities of Duerckheim and of Limburg over the vineyards. Emich of Leiningen, representing the community of Duerckheim, and the Abbott of Limburg, representing the interests of the Church, enter upon a drinking-contest, "the well-known debauch of Hartenburg," in which Emich is victorious and Limburg releases its claims upon the vineyards.

IV. COOPER AND GERMAN CRITICISM

Cooper had all his life to suffer comparison with his great British contemporary, Sir Walter Scott. This was certainly unfortunate and yet inevitable. When Cooper's first novel appeared Scott was at the height of his fame and even more popular in America than abroad. Cooper's second novel, 'The Spy,' had to bear comparison with Scott's 'Antiquary,' which was published simultaneously. Yet there were many literary people in England who looked upon Cooper as the equal of Scott. The latter himself was much impresed with 'The Pilot,' which Cooper had published in 1823 to convince his friends that the author of 'The Pirate' (1821) was not a seaman. The English periodicals, however, were very sparing with their eulogies and thought it sufficient praise to call him "the American Scott," an epithet which has adhered to Cooper ever since. At times this term was used as complimentary to Cooper, but sometimes, too, to express Cooper's inferiority and dependence. It has been pointed out that Continental critics favored Cooper as the equal and even the superior of Scott.[18] In contemporary German reviews Cooper's relations to Scott are frequently dwelt upon. Of course, the German reviewers were sometimes dependent upon the reviews in English periodicals, which were often antagonistic to Cooper. The following reviews culled from German periodicals, may serve as interesting examples of contemporary criticism:

'Literarisches Conversations-Blatt.' Nr. 167. 21. Juli, 1824. 'Der Ansiedler, oder die Quellen des Susquehanna.' Aus dem Eng. des Amerikaners Cooper, von *r. Drei Theile. Lpz. 1824. 8.—Und wäre es nur der Neuheit wegen, indem der Roman einen wenig bekannten Schauplatz uns eröffnet, würde das Buch anziehen; aber es hat reellere Verdienste, die ihm bleibende Werthschätzung versichern. Der Verfasser führt uns *mit der Lebendigkeit und der edeln Einfalt eines Scott* die Gegenden von einem Theile seines Vaterlandes und deren Bewohner vor; wir erkennen aus der Art der Darstellung auch ihre Wahrheit, gleich wie man aus dem trefflch gemalten Bildniss einer uns unbekannten Person die Treue der Abbilding behaupten kann; . . . Washington Irving hat uns Europäern bereits bewiesen, dass unsre Gegenfüssler es kühnlich mit unsern besten Romanendichtern auf-

[18] Cf. R. W. Griswold. 'The Prose Writers of America.' Phila., 1847. 2d Ed. Also T. R. Lounsbury. 'James Fenimore Cooper.' 1883.

nehmen können, und Cooper bestätigt durch vorliegendes Werk diesen Glauben. In Irving's 'Bracebridge-Hall' sehen wir seltner die amerikanische Volksthümlichkeit abgeschildert als die Eindrücke, welche auf ihn, den Bürger der Vereinigten Staaten, die Sitten und äussern Erscheinungen der alten Welt, für ihn eine neue, machten. Cooper hingegen geht durchaus nicht darauf aus, Betrachtungen und Vergleiche über Ehemals und Jetzt, zwischen der alten und der neuen Welt anzustellen, er erzählt eine Geschichte, die sich zu Ausgang des vorigen Jahres in einer Ansiedelung in Nordamerika zutragen gekonnt, erwähnt von der nächsten Vergangenheit nur das zur Verdeutlichung der Begebenheiten Nothwendige, ohne daran zu denken (so scheint es). . . . Er versteht es, den gemischten Zustand einer werdenden Gesellschaft sammt der Nationalität eines immer mehr zum völligen Verlöschen sich neigenden Urvolks vor die Augen zu bringen, Colonisten und Indianer in Verhältnisse zu versetzen, wo sie ihre Gesinnungen und Gefühle, ihr Wesen in seiner Ganzheit enthüllen können, er zeigt den Menschen in jeder Abstufung der Cultur und Alles wie ohne Absicht, aber mit dem Auge, der Hand eines Meisters. . . . Da nicht zu bezweifeln, dass die Ansiedler, und sollten sie die Landsleute kühl aufnehmen, eine europäische Berühmtheit erlangen werden, die Natürlichkeit, die schöne Innigkeit des Gefühls, die Klarheit der Ideen des Verfassers, ihm in Deutschland Freunde und Anhänger erwerben wird, so ist voraus zu setzen, dass der Verfasser . . . die harrende Lesewelt bald mit Romanen beschenken wird, die, wenn sie Familienähnlichkeit besitzen, den besten Dichtungen in der Gattung sich kühnlich an die Seite stellen dürfen.

'Literarisches Conversations-Blatt.' No. 193. 20. August 1825. 'Uber den Spion von Cooper.' Ich habe nun drei Romane van Cooper, und wahrscheinlich (?) in der Folge, wie sie erschienen sind gelesen: Die Ansiedler, den Lootsen, und eben jetzt den Spion . . . wer sie als blosse Romane liest, kann mit Recht sagen: Fragmentarisches Zeug! Rohe Colonisten, tollköpfige Matrosen, Mord- und Brandgesindel im Bürgerkrieg, bald mit Albrecht Dürer'scher Kleinlichkeit, bald in kolossalen Umrissen dargestellt, machen noch keinen Roman. . . . Wenn Cooper hübsch bei seinen brittischen Stammesgenossen in die Schule gegangen wäre, hätte er's anders gemacht.

'Literarisches Conversations-Blatt.' Nr. 4. 5. Januar, 1825. 'Der Lootse von dem Amerikaner Cooper.'—In this chatty review of 'The Pilot,' one German friend says to another: "Das Bild

eines kräftigen Lebens, eines kühnen Todes, wie Tausende es leben, Tausend ihn starben, hat mich aus der Lähmung meines Werktagslebens gehoben. Es bot mir, neben dem raisonirenden und erraisonnirten Muth, mit dem ich den schleppenden Gang meines bürgerlichen Lebens hinschreite, eine Ideenreihe, die mich freudig aufregte; ich weiss nun wieder Menschn, die ich beneiden kann, und habe wieder einen Maasstab für den Werth der Entsagung, die mir mein ruhiger Wohlstand, meine bürgerliche Bestimmung zur Pflicht macht.''

'Literarisches Conversations-Blatt.' 28. Dezember, 1826. 'Cooper's neuester Roman, The Last of the Mohicans.'—Cooper, der ''great American novelist,'' tritt immer noch mit dem sonst sogenannten ''great Unknown'' in England kühn in die Schranken und steht mit Radcliffe, Washington Irving, Walpole und seinem Landsmann Brown auf einer Linie, nur ist Scott mehr noch der Mann des Volkes und um Vieles fruchtbarer und schreibseliger als der Amerikaner, der nach seinem eignen Ausdruck und Geständniss, grösstentheils ''to please himself'' schreibt . . . Freilich wird er sonach weniger reich im Produciren sein als Scott; aber er wird länger produktiv bleiben, und seine Werke werden im Fortschritt der Zeit mehr Jugendfrische und Neuheit bewahren. Für den deutschen Leser hat schon der Schauplatz seiner Romane ein gewisses Interesse. Amerika ist auch der Schauplatz seines neuesten Romans, 'The Last of the Mohicans.' Seine Einbildungskraft findet hier das reichste Feld für die Schilderung der eigenthümlichen Reize des Landes, die er sorgfältig studirt zu haben scheint, für die Darstellung von Charaktern nordamerikanischer Wilden und ihrer Sitten, und für die Folge von Scenen, die den Leser in steter Spannung halten.

'Blätter für literarische Unterhaltung' (earlier, 'Lit. Conversations-Blatt.') 4. August, 1827.—'Cooper's neuester Roman.'—Weltliteratur und doch Tagesliteratur! Die Aussichten, welche sich in dergleichen Unternehmungen für die Weltliteratur eröffnen, sind so gross und weit, dass man davon den Schwindel bekommen könnte. Wir ziehen uns daher von ihnen zurück und wenden uns zu dem neuesten Roman des nordamerikanischen Walter Scott. . . . Denn jener Roman, 'The Prairie,' deutsch 'Die Prairie' betitelt, ist, wie verlautet, höchstens in vier Ländern und drei Sprachen gleichzeitig erschienen, in der Originalsprache zu New York und London, französisch in Paris, und deutsch zu

Berlin. . . . Was à la Walter Scott heisst, das kann man jetzt in jeder Schnittwaarenhandlung lernen, entweder von der Ladenmamsel oder von der Waare selbst. . . . Ich selbst recensire jetzt in einem Schlafrocke und einer Nachtmütze à la Walter Scott.

Denn der neue Cooper'sche Roman muss jedem, auch dem mittelmässigsten Talent—und so hoch stelle ich mich selbst—Muth und Lust einflössen, sich einmal à la Walter Scott zu versuchen, wenn wir nämlich sehen, wie wenig dazu gehört. . . .

Wir finden in Cooper die ganze Breite seines Vorbildes, und überhaupt eine bis auf Bände und Kapitel nachgemessene Gleichheit des Umfangs. Aber während Scott's Breite durch eine charakteristiche Malerei und abwechselnden Colorit ausgefüllt erscheint, malt Cooper uns fast nur Landschaften, Kleidungen und Stellungen vor, ohne in irgend einer Ausführung tief in das Innere seiner Charaktere einzudringen, sodass seine Malerei in Vergleich mit der seines Vorbildes sich als eine oberflächliche zeigt. Die behagliche Bequemlichkeit der Scott'schen Erzählungsweise hat Cooper auch angenommen, aber ihm fehlt die leichte graziöse Ironie, die diese Manier angenehm macht. Die untergeordneten originellen Charaktere der Scott'schen Romane hat der Amerikaner dadurch leicht zu ersetzen vermocht, dass die indianische Fremdartigkeit seines Lokals, oder die eigenthümlich neuen und zum Theil seltsamen Verhältnisse europäischer Colonisation in dem jungfräulichen Lande der grossen Ströme und Seen ihm Originalitäten darboten, die auch ohne bedeutende innere Individualität, schon durch ihre äussere Stellung und Beschäftigung das Interesse des europäischen Lesers als überseeische Wundermenschen in Anspruch nehmen. . . . Betrachten wir diesen Romanstoff ohne Rücksicht auf das Fremdartige und Originelle, welches amerikanische Natur und Lebensweise ihm geben, so erscheint er keineswegs neu oder geistreich in seiner Erfindung. In der Behandlung desselben erkennen wir aber im allgemeinen mehr künstliche Geschicklichkeit als echte Kunst, mehr Manier als Styl; überall ein Hinarbeiten auf Effekt und Spannung, Angst oder Überraschung, und alle Scenen und Begehungen geben sich dem Leser nur zu deutlich als berechnet auf dieses unwesentliche Ziel kund.

'Blätter für literarische Unterhaltung.' 13. Januar, 1829. 'Die Nordamerikaner, geschildert von einem reisenden Junggesellen.' Aus dem Englischen des Amerikaners Cooper. Stuttgart, 1828. The following critique was borrowed from an English

paper: "Wir sind keine Feinde eines mässigen Nationalstolzes, ja selbst Nationalvorurtheile finden, mässig ausgesprochen, an uns Vertheidigung; allein die Art und Weise, wie Herr Cooper, der Romandichter in diesem Buch von Amerika spricht, übersteigt doch alle Grenzen des Erlaubten. Englands oder Spaniens Nationaldünkel ist nichts gegen diesen amerikanischen, wie alle Länder und Völker nach ihm nichts gegen Amerika. Ja mehr, Arkadien ist ein Elsternest gegen Amerika, Eldorado, eine arme Wüste, und das Paradies selber nicht werth, mit Amerika verglichen zu werden. Kurzum, Herr Cooper zeigt sich uns in diesem Buch als der grösste Windmacher, der je Bücher geschrieben hat, und leider oft genug auch ebenso sehr ohne Urtheil wie ohne Wahrheitsliebe. . . . Nach ihm sind die Amerikaner

'Das grosse fehlerlose Ungeheuer
Das nie ein sterblich Aug erblickt.'

Sie sind nach des Verfassers Worten das thätigste, witzigste, betriebsamste, ordentlichste, mässigste, kräftigste, edelste, gerechtigste, männlichste, weiseste, unschuldigste, freisinnigste, civilisirteste, geistvollste, erleuchteste, standhafteste, tugendreichste, biederste, mächtigste, einsichtvollste, tapferste, freiste, wohlregierteste, erhabenste, reinste, feinfühlendste, ausserordentlichste und wunderwürdigste Volk, das je gelebt hat oder noch leben wird, und—was merkwürdig ist, sie sollen täglich noch besser werden!"

In the same periodical of June 13, 1829, an article commenting upon the same work and the above review says: "Inzwischen muss selbst ein Deutscher, dessen Nationalität auf wenig Verfassung, Industrie und Verkehr Anspruch macht, eingestehen, der Amerikaner Cooper sei ruhmredig von seinem Vaterlande und preise im Werk zu breit die Vorzüge desselben."

In the 'Magazin für die Literatur des Auslandes,' of February 13, 1832, appeared a German translation of the criticism of Cooper's 'Bravo,' which had appeared in 'The American' of New York. In the same magazine for September 30, 1833, appeared a review of Cooper's 'Headsman.' "Seitdem Cooper in Europa sich befindet, ist auch seine Muse eine Europäerin geworden. Italien war es zuerst (im 'Bravo'), dann Deutschland (in der 'Heidenmauer'), die er uns vorgeführt, und jetzt hat er uns nach der Schweiz versetzt . . . wir könnten keinen besseren *guide des voyageurs* uns wählen, denn wo er sich niederlässt, hat auch die reizendste Natur ihren Wohnsitz aufgeschlagen, und wo er die Chronik nachgelesen, da sind gewiss die interessantesten histor-

ischen Erinnerungen für uns. Ich sage für uns; denn für ihn, den neuweltlichen Republikaner, sind unsere historischen Denkmäler vorgeblich von keinem Werth. Er gebraucht die Romantik nicht, wie Walter Scott, als eine Fackel, um dunkle historische Landschaften so kunstvoll zu beleuchten, dass Burgen und Schlösser, Ritterthum und Mittelalter in idealer Färbung erscheinen; er betrachtet sie vielmehr als eine Dame, deren Kammerjungfer die Geschichte ist, die hier eine Ritterburg als Kopfputz und dort das Mittelalter als Schminke verwendet."

In the same magazine for August, 1832, appeared a long critique of Cooper in general under the title *Literatur, Beredsamkeit und Poesie in den Vereinigten Staaten.* Von einem Engländer dargestellt. This was taken from the Edinburgh magazine.

'Magazin für die Literatur des Auslandes.' 24. Juli, 1835. 'The Monikins' ('Die Monikins'). Eine Erzählung von Cooper. New York und London, 1835.—'Der Letzte der Mohikaner,' einer der vollendesten Romane, welche die englische Literatur aufzuweisen hat, wird gewiss jedem Leser sogleich einfallen, wenn er den Titel dieses neuen Werkes von demselben Verfasser zu Gesicht bekommt, und er wird in dem Buche irgend eine ähnliche Schilderung von dem Leben in den unerforschten Wildnissen erwarten. Aber er wird sich bitter getäuscht sehen, wenn er sich eine dramatische und romantische Geschichte versprochen. . . . 'Die Monikins' sind in Hinsicht auf Plan und Zweck den Reisen Gulliver's von Swift nicht unähnlich, stehen aber an Witz und Scharfsinn weit hinter diesen Zurück und sind keineswegs so unterhaltend. Der Verfasser scheint dabei den Hauptzweck vor Augen gehabt zu haben, eine vergleichende Darstellung der politischen Systeme von Nord-Amerika und England zu liefern, jedoch in eine phantastische Hülle gekleidet, durch welche die unmittelbare Absicht verdeckt und der Autor in den Stand gesetzt wird, seine Thema in regelloser und hin- und herschweifender Laune zu behandeln.[19]

'Magazin für die Literatur des Auslandes.' 16. März, 1840.—Der amerikanische Schriftsteller ist wieder auf dasjenige Gebiet zurückgekehrt, auf welchem er am meisten heimisch ist. . . . Sein neuestes Werk ist weder eine Darstellung des europäischen Modelebens, noch ein Geschichtchen aus der Weltgeschichte, sondern ein auf dem Meere und in den Savannen der Indianer spielenden Roman unter dem Titel 'Der Weg-Auffinder oder das Bin-

[19] Cf. also M. Müller, 'The Monikins v. J. F. Cooper in ihrem Verhältnis zu Gulliver's Travels of Swift.' Diss. Rostock.

nenmeer' ('The Pathfinder or the Inland Sea.' A romance by J. Fenimore Cooper). Amerikanische Kritiker sind der Meinung, dass dieses neue Werk zu dem Besten gehöre, was der Verfasser bisher geliefert und vielleicht nur dem 'Letzten Mohikaner' nachzustellen sei. Die Sitten der Indianer werden darin treu geschildert, während zugleich Liebe und Aufopferung mit den wahrsten Farben, also auch in einer anderen Weise, wie es Chateaubriand in seiner 'Atala' thut, dargestellt werden.

'Magazin für die Literatur des Auslandes.' 18. Januar, 1841. 'Mercedes von Castilien; ein Roman aus der Zeit des Columbus.'—In diesen drei Bänden wird die Geschichte von Columbus' erster Reise zu einem gewöhnlichen See-Romane voller nautischen und Liebes-Abenteuer ausgebeutet. . . . Nur die Seeschilderungen sind wieder ganz vortrefflich und geben den besten Darstellungen dieser Art, die wir bereits um Cooper besitzen, nichts nach; alles Übrige jedoch ist langweilig über die Massen.

'Magazin für die Literatur des Auslandes.' 22. August, 1846. 'Ein politischer Tendenzroman von Cooper.'—Aus der Vorrede zu Cooper's 'Schanzgräbern' ersehen wir, wie der Oppositionsgeist vor 24 Jahren den populärsten amerik. Novellisten zum Schriftsteller machte. Nach seinem neuesten Roman 'Ravensnest' (The Amer. Ed. is known as 'The Redskins') zu schliessen, scheint es, dass derselbe Oppositionsgeist seine Erfindungskraft in Thätigkeit erhält. . . . Nun ist aber der Roman und nicht die Politik die starke Seite unseres Verfassers; eine Seite aus seinem 'Letzten Mohikaner' oder der 'Prärie,' oder dem 'Piloten,' oder dem 'Bravo,' ist mehr werth, als die 900, welche diese 3 Bde. enthalten.

'Magazin für die Literatur des Auslandes.' 27. Mai, 1848.—Der berühmte Verfasser des 'Spion' und 'Der Mokikaner' hat wieder einen Roman vom Stapel gelassen: 'Captain Spike, or the Islets of the Gulf;' London, 1848 (in America known as 'Jack Tier'): der aber ähnliche Symptome der Erschöpfung an sich trägt, wie seine unmittelbaren Vorgänger. Wer letztere durchblättert hat, wird sich den Inhalt dieser neuesten Erzählung des amerikanischen Walter Scott ohne Mühe denken können; es ist dieselbe Geschichte unter anderen Namen, nur dass statt des Freiheitskampfes von 1776 oder des franz. Revolutionskrieges der jetzige Krieg der Vereinigten Staaten mit Mexiko den historischen Boden zu dem romantischen Gebäude liefern muss. . . . Es versteht sich übrigens von selbst, dass es hier wie bei allen Werken Cooper's, nicht an interessanten Einzelheiten fehlt, und unter den

Auspizien unserer fingerfertigen Übersetzungskünstler wird daher 'Captain Spike' gewiss recht bald einen Ehrenplatz in den deutschen Lesebibliotheken einnehmen.

'Magazin für die Literatur des Auslandes.' 15. Juni, 1850.—Unter dem mysteriösen Titel: 'Die Wege (oder Weisen) der Stunde' ('The Ways of the Hour'). London, 1850, hat Cooper einen neuen Roman vom Stapel gelassen, den er dem Publikum als sein 'letztes Werk' ankündigt. . . . In der vorliegenden Arbeit zeigen sich noch keine Spuren von Altersschwäche; sie ist so interessant wie irgend eines seiner früheren Werke, obwohl die ganze Intrigue aus einem Gewebe von Unwahrscheinlichkeiten besteht. Die Handlung geht zwar in Amerika vor, und die Sitten und Gebräuche, die Schwächen und Gemeinheiten des amerik. Volkes werden mit der gewöhnlichen Meisterschaft und mehr als der gewöhnlichen Bitterkeit des Verfassers geschildert.

The above are but a few of the many reviews and notices which appeared about the works of Cooper.[20] They will suffice to show the general attitude of the German critics toward the first American novelist to win fame on the Continent. The 'Magazin für die Literatur des Auslandes,' which, by virtue of its character, contains more references to the works of Cooper than other periodicals, also frequently printed extracts from his latest works.[21]

The verisimilitude of Cooper's Indians has long been a favorite subject for controversy, and has grown to be a common place of literary criticism. More recent critics point out that Cooper in no wise idealized the Indian, that he only emphasized his picturesque qualities, and that Cooper's Indian is after all not so far removed from the American Indian as he was before he had come into contact with the Whites.[22] It has even been pointed out that Cooper conscientiously refrained from idealizing the Indian and

[20] For others see 'Lit. Conversations-Blatt.' 7 März, 1825, 'Der Spion;' 20. Juli, 1825, 'Lionel Lincoln;' also 'Blätter für lit. Unterhaltung.' 6. März, 1828, 'Red Rover'; also 'Mag. für Lit. d. Auslandes.' 11. Juli, 1836, 'Schilderungen der Schweiz'; 17. Februar, 1837, 'Erinnerungen aus Europa'; 18. Juni, 1838, 'Die Heimfahrt, eine See-Novelle;' 6. Februar, 1839, 'Eva Effingham (Home as Found);' 20. November, 1843, 'Wyandotte, oder der Hütten-Hugel;' 26. Oktober, 1844, 'Zur See und zu Lande' ('Afloat and Ashore').

[21] On October 21, 1836, appeared Cooper's 'Ansichten über seine Landsleute' (an extract from 'A Residence in France'); March 15, 1837, 'Cooper und Walter Scott in Paris,' from the novelist's 'Recollections of Europe'; April 2, 1838, 'Cooper und die Engländer,' from his 'Italian Excursions'; April 4, 1838, 'Rom und die Brücke bei Lodi,' from Cooper's 'Italian Excursions'; November 22, 1843, 'Amerikanische Naturscenen,' from 'Wyandotte'.

[22] Cf. W. C. Brownell: 'Cooper.' Scribner's Magazine. April, 1906. Also Lilli D. Loshe: 'The Early American Novel.' New York, 1907.

has not hesitated to show his treachery and cruelty. Cooper's Indian will probably continue to be a subject for controversy.[23]

In Germany, too, there were some critics who early questioned the reality of Cooper's Indians. In 'Das Ausland. Eine Wochenschrift für Kunde des geistigen und sittlichen Lebens der Völker,' 10. März, 1861, there is a notice of a book on 'Travels in America,' by Alexis de Tocqueville, the famous author of 'Démocratie en Amérique.' This book, though written in 1831, had just appeared in Paris. The German reviewer relates how de Tocqueville, filled with the images of Cooper and Chateaubriand, saw his first Indians in Buffalo on Lake Erie, and how keenly disappointed he was to see such wretched specimens of humanity. "Er hatte halbnackte, kräftige, trotzige Krieger im wilden Putze erwartet, denn es waren ja die Reste der mächtigsten aller nördlichen Nationen, der Irokesen, welche er in Buffalo sah. Statt Rothhäute, gewahrte er aber bronzefarbige, kümmerliche Gestalten, mit glänzenden, aber groben schwarzen Haaren in entstellenden europäischen Kleidern, die er für Mulatten hätte halten mögen. . . ."

The excessive refinement of some of the author's Indians provoked criticism. In a review of the 'Last of the Mohicans' in the 'Lit. Conversations-Blatt' for December 28, 1826, we read: "Zuweilen jedoch passirt es dem American Novelist, dass er seinem Wilden gar zu viel Feinheit beilegt. Als Beweis nur diesen Zug: Major Duncan Heyward überlässt die Vertheidigung Coras dem Uncas, der ihr höflich den Arm bietet, welchen sie freudig annimmt." I have considered elsewhere Fanny Lewald's delightful travesty on Indian tales 'Diogena' (1847), in which the heroine, thoroughly disappointed in the Indians she has met in America, exclaims: "O, wo blieben meine Hoffnungen! was fand ich in dieser horribeln Realität von den Idealen Cooper's?"

The novelist Friedrich Spielhagen in the Vorwort to his translations 'Amerikanische Gedichte' (1872) writes, in a passage, perhaps more effective than critical: "Die ahungsvolle schwermüthige Beleuchtung einer untergehenden Sonne, die er auf seine letzten Mohikaner fallen lässt, hatte für einen Moment eine recht hübsche Wirkung hervorgebracht, aber das grelle Licht der Kritik zerstörte nur zu bald diesen zauberhaften Schimmer. Man fand, dass diese Indianer sehr schmutzige, rohe und grausame Bursche waren, und wolle nicht mehr an ihre unvergleichliche Tugend und Ritterlichkeit glauben."

Whatever attitude the reader may take toward the Indian as

[23] Cf. W. P. Trent and John Erskine: 'Great American Writers.' 1912.

portrayed by Cooper, the fact nevertheless remains that to the early readers of Cooper who knew no other Indians than the creations of Chateaubriand, and also to the majority of his subsequent European readers, the Indian as depicted by Cooper seemed intensely real.

The female characters in Cooper's novels furnished another favorite topic for controversy. They have called forth a good deal of adverse criticism.[24] Long before Lounsbury had his delightful fling at them, Cooper's females had already called forth unfavorable criticisms from the Germans. Sealsfield, who found little to satisfy him in any author, in his 'George Howard's, Esq., und Ralph Dougby's, Esq., Brautfahrt,' incidentally gives his opinion of Cooper's heroines in the following characterization of American women: "Die Bostonerinnen sind verstandreicher, ihre Gesichtszüge regelmässiger, aber sie haben etwas Yankeeartiges, das mir nicht susagt; zudem ist ihre Taille ein Artikel, an dem ich immer das Wichtigste vermisse, nämlich den Busen. . . . Dabei sind sie so verwünschte Bluestockings. Die Philadelphierinnen sind runder, elasticher . . . aber die Newyorkerinnen, besonders wenn so ein letzter Mohikan oder Redrover erschienen, sind ganz unvergleichliche Coras und Alices, zum malen natürlich! *Cooper, ich wette darauf, würde er sie nur sehen, zerrisse seine Manuskripte, und bildete seine Damen weniger hölzern.*" Dr. K. Brunnemann in his 'Geschichte der nordarmerikanischen Literatur' (2. Ausg. Lpz. 1868) writes: "Zwar in gewissen Beziehungen steht Cooper andern Romanschriftstellern nach; so fehlt es z. B. seinen Frauencharakteren fast durchweg an Individualität."

It may not be out of place to add here a number of other contemporary general criticisms of Cooper's works, which have come to my notice. Goethe wrote in his 'Diary' for June 25, 1827: Den 2. Theil der 'Prairies' geendigt; on June 26th: "Las den Cooperschen Roman bis gegen das Ende und bewunderte den reichen Stoff und dessen geistreiche Behandlung. Nicht leicht sind Werke mit so grossem Bewusstsein und solcher Consequenz durchgeführt als die Cooperschen Romane."

An essay in the 'Magazin für die Literatur des Auslandes' for December 2, 1839, under the title 'J. F. Cooper als Geschichtsschreiber' contains the following: "So lange Cooper auf dem Gebiete der Dichtung, zu Wasser oder zu Lande, blieb, war er der Stolz der neuen Welt, und Amerika hatte einen Schriftsteller, um

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[24] A reaction in favor of Cooper's heroines has set in. Cf. W. C. Brownell's 'Cooper' in Scribner's Magazine. April, 1906; and Leon H. Vincent's 'American Literary Masters.' 1906.

welchen es von der alten Welt beneidet werden konnte. Aber sein böser Stern führte ihn nach Europa und liess ihn hier seinen schönen Ruhm der Gefahr des Sichüberlebens preisgeben.

Seit 1836 hat Cooper mehrere Werke herausgegeben, in welchen er alle Welt und noch einige Dinge kleinlich und engherzig bespricht. In einem Buche ('A Residence in France,' etc., 1836) geht er gar so weit, an das Heiligthum der amerikanischen Eigenliebe zu greifen. Er bezüchtigte seine Landsleute eines Theiles dessen, wessen man sie gerechterweise bezüchtigen darf, aber in so herausfordendem Tone. dass die lächerliche Eitelkeit der amer. Menschen (amer. Volk kann man nicht gut sagen) in Harnisch fuhr. Diese Menschen haben zwei empfindliche Punkte in ihrem Charakter. Der erste ist, wenn man ihrer Neigung, durch jedes Mittel Geld zu sammeln, ein Hinderniss in den Weg legen will; der zweite ist, wenn man von dieser Neigung übel spricht. Cooper hat Letzteres gethan und dadurch die Wuth seiner Landsleute so gereizt, dass sie vielleicht das Lynch-Gesetz an ihm vollzogen hätten, wäre er in Amerika gewesen(!)."

In the same magazine for December 13, 1849, we read under the title 'Henry Wadsworth Longfellow und die amerikanische Literatur': "In den beliebten Romanen Cooper's bemüht sich der Verfasser, nationale Typen zu zeichnen, uns die Wilden, die Pflanzer, die Pioniere, die Ansiedler der Wüste zu schildern, und man muss gestehen, dass er seine Aufgabe mit Geschicklichkeit und Erfolg, wenn auch nicht mit Genialität ausführt; statt aber in der jungfräulichen Natur, die ihn umgiebt, sich neue glänzende Farben zu holen, hat er beständig ein Muster vor sich, das er mit oder ohne Bewusstsein kopirt. Er malt die amer. Landschaft mit Hülfe der von Walter Scott angefertigten Schablonen, seine Personen betreten die Scene mit dem Anstande der Helden Walter Scott's wie bei Walter Scott bewegt sich die Handlung grösstenteils in dialogischen Formen, ja, höchst wahrscheinlich hätte Cooper nie daran gedacht. das amer. Nomadenleben zu schildern, wenn ihm das Nomadenthum der Waverly-Romane mit ihren Häuptlingen, Bettlern, Schmugglern und Banditen nicht vorgeschwebt und der hohe Ruf des schottischen Novellisten seinen Ehrgeiz und sein Talent nicht aufgestachelt hätte. . . . Trotz seiner Fehler, halten wir Cooper in dem von ihm erwählten Fache für das ausgezeichnetste Talent, welches die Vereinigten Staaten bisher aufzuweisen haben."

Here too must be mentioned the interesting remarks made by Charles Sealsfield in the 'Zuschrift' to his 'Morton oder die

grosse Tour.' Speaking of Scott, he says: "Seine Charaktere sind wahr, aber nicht übertrieben, wie dies beim Verfasser des 'Last of the Mohicans' der Fall ist. . . . . Sie finden in den ganzen Vereinigten Staaten keine Tröpfe, die sich so herumzerren lassen, wie Leatherstocking, keinen Kentuckier, der so, *quasi* die Kappe in der Hand, vor dem Kapitän dastehen würde, wie es in der 'Prärie' der Fall ist. Der Verfasser, ein Seemann, hatte die Seedisciplin auf das feste Land übertragen, und darin hat er gefehlt; denn der Amerikaner des festen Landes ist ein ganz verschiedenes Wesen von dem Amerikaner, der auf einem Schiffe eingezwängt ist. Ich habe alle Achtung für die Seeromane dieses ausgezeichneten Schriftstellers. Das war sein Kreis, innerhalb dieses war er mehr als blosser Nachahmer Walter Scotts, er war Original,—und hat genützt, sehr viel genützt, denn er hat den seefahrenden Geist der Nation gekräftigt, und eben durch die neue Richtung, die er eingeschlagen, gewissermassen dargelegt, dass die amerikanische die erste seemännische Nation ist. Am wenigsten bin ich mit seinem 'Travelling Bachelor' einverstanden. Ein solches Buch fordert eine wissenschaftliche Vorbildung, die dessen Verfasser nicht besitzt, und deren Mangel er durch eine unausstehlich exclusive Tournure nichts weniger als ersetzt. Er ist hier absoluter Aristokrat, stocksteifer Aristokrat, und so steif unsere Geldaristokratie ist, so, wie sie der Autor gerne haben möchte, ist sie zum Glücke noch nicht; . . . Es weht durch diese Bücher, wie gesagt, ein so starrer, unliebenswürdiger, ja inhumaner, exclusiver Geist, wie ich ihn selten gefunden, und der zur Ehre der Vereinigten Staaten auch durch eine allgemeine kalte Aufnahme des Buches gewissermassen missbilligt wurde."

A more favorable criticism than the previous one is that of Ludwig Börne.[25] It is full of the 'Young German' spirit of discontentment with conditions as they existed in Germany at the time when the only hope for the thousands of 'Europamüden' lay in America. Börne writes in part: "Wenn Goethe's Grundsatz wahr ist: der Held eines Romanes müsse sich sehr leidend verhalten, müsse sich alles gefallen lassen und dürfe nicht mucksen—warum haben wir keine guten Romane, da wir doch alle geborne Romanhelden sind? Wir haben keine, *weil* der Grundsatz wahr ist: Um etwas zu erfahren, muss man etwas thun; wir müssen gehen, dass uns etwas begegne. . . . Kaiser Augustus,

[25] See 'Cooper's Romane' in Ludwig Börnes' 'Gesammelte Schriften.' 3. Bd. s. 65.

der Schelm, sagte, als er einst bei Tische zwischen dem tiefäugigen Horaz und dem engbrüstigen Virgil gesessen: da sitze ich zwischen Thränen und Seufzern. Ganz so kaiserlich speisen wir auch, so oft wir deutsche Romane lesen. . . . *Eine Million für einen Roman!* Bemüht euch, zappelt, rennt—ihr bringt so wenig einen Roman zustande, als ich die Million herbeischaffe. Doch was liegt daran? Es giebt nichts Lächerlicheres als volkstümliche Gefühle, es ist nichts kindischer als Vaterlandsliebe. Die ganze Menschheit ist *ein* Volk, die ganze Erde ist *ein* Land; Gaben, Mühen und Genüsse sind verteilt—die Engländer *schreiben* Romane und wir *lesen* sie.

Ja, wenn es bloss die Engländer wären! Dass aber selbst die Amerikaner es uns zuvorgethan, so ein junges Volk, das kaum die schwäbische Reife erlangt, das beschämt, das entmutigt. Washington Irving, Cooper und noch andere! Wäre Cooper ein ausgezeichneter Künstler, wie Walter Scott es ist, das möchte uns beruhigen. . . . Solch ein Genius aber ist Cooper nicht. Manche Deutsche kommen ihm gleich an Kunstfertigkeit; er hat nur vor ihnen voraus, dass er ein Amerikaner ist—versteht ihr? dass er ein Amerikaner ist. Das haben auch die deutschen Ubersetzer seiner Romane gefühlt, und sie haben darum auf dem Titelblatte dem Namen Cooper das Beiwort Amerikaner vorgesetzt. Es ist ein Titel wie ein anderer, wie Doktor, wie Hofrat. Ja, hätten sie geschrieben: 'Seine Excellenz, der Herr Amerikaner Freiherr von Cooper'—man hätte es gern gelesen, und hasste man auch noch so sehr die Titel. Ein Freiherr ist er gewiss und die Excellenz gebührt ihm wohl.

In Cooper's Romanen handeln frische, jungfräuliche Menschen, frisch und jungfräulich wie ihre Natur es ist. Sie haben ihre Schwächen und Laster, wie wir auch; aber die Krankheiten der Seelenleidenden sind kenntlichen Ausdrucks und geregelten Ganges, nicht wie bei uns getrübt und verworren durch einfliessende Nervenschwäche und Romantik. Ihre Lebensverhältnisse sind klar und heiter, nicht als atmeten sie im Rosenschimmer unvergänglicher Freuden; sie kennen den Schmerz wie wir; . . . Dort sind die Bürger ihrer Rechte klar, ihrer Pflichten sich froh bewusst; denn ihre Pflichten sind auch ihre Rechte. Das Gesetz des Bürgers und des Staates ist dort blank, stark geprägt und scharf gerändert, wie es aus der Münze der Natur gekommen; nicht beschmutzt von den Händen bestochener Richter, nicht vergriffen und beschnitten von den tausend Fingern der hundert

Schreiber, Advokaten und Mäkler des Rechts. Doch das wird der verständige Leser schon alles vonselbst heraus finden, und ist er ein Freund—guter Bücher, wird er nicht ermangeln, die Romane Coopers nach Möglichkeit zu empfehlen.''

V. GERMAN TRANSLATIONS OF COOPER'S WORKS

It is safe to say that the works of no other novelist have been so widely circulated in translation. This was hardly due to the excellence of the German translations themselves. Some of the German translations were poor enough. Goethe, upon reading a German translation of 'Red Rover,' noted in his 'Diary' for January 28, 1828: " 'Red Rover,' deutsche Übersetzung 1. Thl., es fehlt viel, dass sie gut sey. Man sieht ihr wie andern solchen Arbeiten die Eile an. Wenn sich der Ubersetzer nicht in seinen Autor vertieft und verliebt, so kommt oft gerade bey den Hauptstellen etwas Spielendes und Unsicheres zum Vorschein, wodurch der intentionirte Eindruck, die absichtlichste Darstellung gestört wirde." Cooper's popularity in Europe was due rather to the fact that the material was such that permitted readily of translation. It made a common appeal. William Cullan Bryant thought his wide fame was due to the fact that Cooper's excellences were all of such a nature that permitted readily of translation into other languages.[26]

In 1872 Spielhagen expressed the idea that if a writer wished to entertain the public longer with Indian material he must forsake the field of history and confine himself to the purely legendary, as Longfellow had done in his 'Hiawatha.'[27] Goedeke, the German literary historian, in 1881 thought of his boyhood days fifty years earlier when he so eagerly devoured 'The Pilot' and 'The Prairie,' and exclaimed with a sigh of regret: "Wer liest sie noch?"[28] I append a list of German translations and adaptations of Cooper's works from the first translation in 1824 down to the present day, a list which shows that Cooper's novels continue to entertain a public which has come into being since Spielhagen's generation. In this list is also contained the answer to Goedeke's wistful question. 'The Leatherstocking Tales' are still eagerly read by the German school boy, and quite as much as by the American. They have become German household words. The recent German boy scouts have been fittingly termed 'Die Pfadfinder,' and the German student of today greets the last bottle of wine at a "feuchtfröhliche Sitzung" as 'Der letzte Mohikaner.' This list of translations and adaptations from Cooper's novels, which I believe to be a comprehensive one, is arranged, as nearly as has been possible, in the chronological order of their appearance:

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[26] Cf. 'Commemorative Discourses.' Prose Writings. N. Y. 1884. Vol I.
[27] Cf. Vorwort to 'Amerikanische Gedichte.' Lpz. 1872.
[28] Cf. 'Geschichte der Deutschen Dichtung.' 3. Bd. 1881. s. 1345.

1824.—'Die Ansiedler oder die Quellen des Susquehanna.' Übersetzt von L. Hermann. 3 Bde. Leipzig. Klein.

'Der Ansiedler, etc.;' aus d. Engl. v. *r. Lpz. Wienbrack.

'Der Spion.' Roman aus d. nordamer. Revolutionskriege; übersetzt von L. Hermann. Lpz. Klein.

'Der Spion, od. das neutrale Land.' Aus d. Engl. v. *r. Lpz. Wienbrack. 2. Aufl. 1826. Auch Lpz. Focke.

'Der Lootse, od. Abentheuer an England's Küste.' Lpz. Wienbrack.

1825.—'Lionel Lincoln, od. die Belagerung von Boston.' Aus d. Engl. *r. Lpz. Wienbrack. Auch übersetzt v. Chr. Michaelis Lpz.

1826.—'Der Spion.' Eine Erzähl. aus d. amer. Kriege. Hrsg. v. Chr. Fischer. Frankfurt a. M. Sauerländer.

'Der Letzte der Mohikaner.' Eine Erzähl. aus d. J. 1757. aus d. Engl. von H. Döring. Ebendaselbst.

'Die Ansiedler.' Aus d. Eng. von Juditta. Ebendaselbst.

'Der Spion, od. das neutrale Land.' Hrsg. v. Ph. Petri. 3 Bde. Göttingen.

'Der Letzte der Mohicans.' Eine Erzählung aus d. J. 1757. Braunschweig. Vieweg. Stuttgart. Brodhag. Lpz. Lauffer.

1827.—'Der Lootse.' Ein Seegemälde; aus d. Engl. v. M. Treu. Frankfurt a. M. Sauerländer. 1827-1828.

'Die Prairie.' Ein Roman; aus d. Engl. übers. Berlin. Duncker u. H.

1828.—'Lionel Lincoln;' übers. v. K. Meurer. Frankfurt a. M. Sauerländer.

'Die Steppe;' übers. v. K. Meurer. Ebendas.

'Red Rover;' aus d. Engl. von G. Friedenberg. Berlin. Duncker u. H.

'Der rothe Freibeuter.' Eine Erzähl. aus d. Engl. v. K. Meurer, Frankfurt a. M.

'Der Nordamerikaner,' geschildert von einem reisenden Junggesellen. Stuttgart. Brodhag.

1829.—'Der Nordamerikaner.' Übers v. Ungewitter. Frankfurt a. M. Sauerländer.

'Die Gränzbewohner (Puritaner), oder die Beweinte von Wisch-Ton-Wisch;' aus d. Engl. v. K. Meurer. Ebendas.

'Comanchet u. die Puritaner in Connecticut;' aus d. Engl. v. Gfr. Friedenberg. Berlin. Duncker u. H.

1830.—'Die Wassernixe, od. der Streicher durch die Meere;' aus d. Engl. v. Gfr. Friedenberg. Berlin. Duncker u. H.

1831.—'Die Wassernixe, od. die Tummler der Meere.' Eine Erzählung; aus d. Engl. vom Bearbeiter der humorist. Geschichte New-Yorks, v. W. Irving. Frankfurt a. M. Sauerländer.

1832.—'Der Bravo.' Aus d. Engl. übers. Ebendas.

'Der Bravo.' Eine venetian. Geschichte; aus d. Engl. von Dr. Gfr. Friedenberg. Berlin. Duncker u. H.

'Die Heidenmauer, oder die Benediktiner;' aus d. Engl. v. Th. Sporschil. Braunschw. Vieweg.

1833.—'Die Heidenmauer.' Frankfurt a. M. Sauerländer.

'Der Scharfrichter von Bern, oder das Winzerfest.' Ebendas.

1834.—'Der Henker, oder das Winzerfest.' Roman. Aus d. Engl. v. Jh. Sporschil. Braunschweig. Vieweg.

1835.—'Die Monikins.' Übers. v. Karl Meurer. Frankfurt a. M. Sauerländer.

'Die Meerkatzen.' Aus d. Engl. Braunschweig. Vieweg u. Sohn.

1836.—'Ausflüge in die Schweiz.' Aus d. Engl. übers. v. C. F. Nietsch. Frankfurt a. M. Sauerländer.

'Die Monikins.' Eine wunderbare Geschichte. Aus d. Engl. v. Geo. Bärmann. Zwickau. Schumann.

'Streifereien durch die Schweiz.' Aus d. Engl. v. Bärmann. Berlin. Duncker.

1837.—'Aufenthalt in Frankreich, Ausflug an den Rhein und zweiter Besuch in der Schweiz.' Aus d. Engl. v. Nietsch. Frankfurt a. M. Sauerländer.

'England u. das sociale Leben d. Hauptstadt.' Übers. v. Nietsch. Ebendas.

'Erinnerungen an Europa.' Übers. v. Nietsch. Ebendas.

'England. Mit Skizzen aus den Gesellschaften der Residenz.' Aus d. Engl. v. A. v. Treskow. Quedlinburg. Basse.

'Erinnerungen aus Europa.' Aus d. Engl. v. F. Steger. Braunschweig. G. Meyer, Sen.

'Erinnerungen aus Europa.' Aus d. Engl. v. A. v. Treskow. Quedlinburg. Basse.

'Lebensbilder aus Frankreich, den Rheinländern und der Schweiz.' Frei nach d. Engl. von F. Steger. Braunschweig. G. Meyer, Sen.

1838.—'Italien.' Aus d. Engl. v. Nietsch. Frankfurt a. M. Sauerländer.

'Die Heimfahrt, oder die Jagd.' Seeroman. Aus d. Engl. v. Nietsch. Ebendas.

'Wanderungen in Italien.' Nach d. Engl. v. F. Steger. Braunschweig. Vieweg.

'Die Heimfahrt, oder die Jagd.' Übers. v. Joh. Sporschil. Leipzig. Tauchnitz, Jun.

1839.—'Evchen Effingham oder die Heimath.' Eine Fortsetzung 'der Heimfahrt.' Aus d. Engl. v. Nietsch. Ebendas.

'Der Spion.'—'Der Letzte der Mohikaner.'—'Die Ansiedler.'—'Der Lootse.' Neue Ausgabe mit Cooper's Bildniss. 4 Bde. Frankfurt a. M. Sauerländer.

'Lionel Lincoln.'—'Die Steppe.'—'Der rothe Freibeuter.'—'Die Grenzbewohner.'—'Die Wassernixe.'—'Der Bravo.' Neue Ausgabe. 6 Bde. Ebdas.

1840.—'Geschichte der nordamerikan. Seemacht u. ihrer Kriegsthaten.' Aus d. Engl. übers. v. H. Künzel. Ebendas.

'Der Pfadfinder oder der Binnen-See.' Aus d. Engl. übers. Ebendas.

'Der letzte Mohikan.' Übers. v. L Tafel. Stuttgart. Liesching.

1841.—'Der Pfadfinder oder das Binnenmeer.' Übers. v. G. Kolb. Ebendas.

'Mercedes von Castilien.' Ein Roman aus den Tagen des Columbus. Frankfurt a. M. Sauerländer.

'Der Hirschtödter.' Aus d. Engl. v. O. v. Czarnowski. Ebd. 1841-1842.

'Die Wassernixe.'—'Der Spion.' Stuttgart. Liesching.

'Der Spion.' Nach der von dem Verfasser durch gesch., verb., mit einem neuen Vorwort u. mit Noten begleit. Ausg. übertragen v. C. Kolb. Ebd.

'Donna Mercedes von Castilien.' Übers. v. C. Kolb. Ebd.

'Der rothe Seeräuber.' Engl. v. Gottfr. Friedenberg. Ebd.

'Die Beweinte von Wish-Ton-Wish.' Engl. v. Gottfr. Friedenberg. Ebd.

1842.—'Die zwei Admirale.' Ein Seeroman. Frankfurt a. M. Sauerländer.

'Lionel Lincoln, oder die Belagerung von Boston.' Nach der letzten vom Verf. durchgeseh., verb. u. mit Anmerk. verseh. Ausg. übertr. von Ed. Mauch. Stuttgart. Liesching.

'Der Wildtöter.' Eine Erzählung. Eng. v. Gust. Pfizer. Ebd.

'Die Prairie' (Steppe). Eine Erzählung. Engl. v. Gottfr. Friedenberg. Ebd.

'Die Ansiedler an den Quellen des Susquehanna.' Ebd.

'Der Lootse.' Ein Seegemälde. Engl. v. Ed. Mauch. Ebd.

1843.—'Die beiden Admirale.' Ein Seeroman. Engl. v. Ed. Mauch. Ebd.

'Der Irrwisch oder das Kaperschiff.'—'Der Bravo.' Ebd.

'Das Irrlicht oder der Kaper.' Frankfurt a. M. Sauerländer.

1844.—'Wyandotté oder der Hütten-Hügel.' Ebd.

'Ned Myers oder ein Vormast-Leben.' Ebd.

'Zu See u. zu Land, oder Abentheuer des Miles Wallingford.' Ebd.

'Wyandotté oder das Blockhaus.' Engl. v. Ed. Mauch. Stuttgart. Liesching.

'Edward (?) Myers, oder Erinnerungen aus dem Leben eines Seemannes.' Deutsch bearbeitet von Erwin v. Moosthal. Im belletristischen Ausland. Hrsg. v. Carl Spindler. Stuttgart.

'Der letzte Mohikan.'—'Der Pfadfinder.'—'Der Ansiedler am Susquehanna.'—'Die Prairie.'—'Der Lootse.'—'Der Spion.'—'Lionel Lincoln.'—'Der rothe Freibeuter.'—'Die Beweinte von Wish-Ton-Wish.'—'Die Wassernixe.'—'Donna Mercedes von Castilien.'—'Der Wildtödter.'—'Die beiden Admirale.'—'Der Irrwisch, oder der Kaper.'—'Der Bravo.'—'Wyandotté oder das Blockhaus.'—'Ned Myers.'—'Die französische Erzieherin.'—'Miles Wallingford.'—'Lucy Hardinge.' Ausgabe mit Titelbildern in Stahlst. Stuttgart. Liesching. 1844, 1845, 1846.

'Miles Wallingford's Abentheuer.' Hrsg. v. Fd. Philippi. Grimma. 1844, 1845.

1845.—'Ned Myers. Aus dem Leben eines Vorkastellmatrosen.' Engl. v. Ed. Mauch.—'Die französische Erzieherin, oder das gestickte Taschentuch. Engl. v. Ed. Mauch.—'Miles Wallingford's Abentheuer zu Land u. zur See.' Engl. v. Ed. Mauch. Stuttgart. Liesching.

'Lederstrumpf-Erzählungen.' Für die Jugend bearb. v. Frz. Hoffman. Stuttgart. Schmidt u. Spring.

'Die Heidenmauer.'—'Satanstoe oder die Familie Littlepage.'—'Die Heimkehr oder die Verfolgung.'—'Der Scharfrichter.'—'Eva Effingham.'—'Der Kettenträger.' Stuttgart. Liesching. 1845, 1846.

'Lucy Hardinge.' Fortsetzung des Romans: 'Zu See u. zu Land. Frankfurt a. M. Sauerländer.

1846.—'Satanszehe oder die Familie von Littlepage.' Ebd.

'Der Kettenträger od. die Familie v. Littlepage.' Eine Erzählung aus der Colonie. Ebd.

'Ravensnest oder die Rothhäute.' Erzählung aus der Colonie. Ebd

1847.—'Ravensnest.' Stuttgart. Liesching.

'Die Heidenmauer.' Eine Rheinsage. Engl. v. C. Kolb. Ausgabe mit Titelbildern. Ebd.

'Die Heimkehr.' Ebd.

'Lucy Hardinge.' Fortsetzung u. Schluss v. Miles Wallingford's Abenteuer. In's Deutsche übertr. v. A. Kretzschmar. Grimma.

1848.—'Mark's Riff oder der Krater.' Frankfurt a. M. Sauerländer.

'Eva Effingham oder die Heimath.' Stuttgart. Liesching.

'Der Scharfrichter.'—'Satanstoe.' Ebd.

'Mark's Riff od. der Krater.' Engl. v. C. Kolb. Ebd.

'Das Marcus-Riff od. der Krater.' Übers. v. G. Bärmann in 'Dem belletristischen Ausland.' Stuttgart. Hrsg. v. Carl Spindler.

1849.—'Capitän Spike oder die Golf-Inseln.' Frankfurt a. M. Sauerländer.

'Die Seelöwen oder die verlorenen Robbenjäger.' Ebd.

'Der Kettenträger oder die Handschriften der Familie Littlepage.' Stuttgart. Liesching.

'Ravensnest oder die Rothhäute.' Ebd.

'Die französische Erzieherin oder das gestickte Taschentuch.' Engl. v. Ed. Mauch. Ebd.

1850.—'Der Bienenjäger oder die Eichen-Lichtungen.' Frankfurt a. M. Sauerländer.

'Die Seelöwen.' In's Deutsche übertr. v. Joh. Hack. Grimma.

1851.—'Der Lootse.' Ein Seegemälde. Engl. v. Ed. Mauch. Stuttgart. Liesching.

'Der Wildtödter.'—Die beiden Admirale. Engl. v. Ed. Mauch. Ebd.

'Der Bravo.' Frankfurt a. M. Sauerländer.

1853.—'Cooper's amerikanische Romane,' neu aus dem Engl. übertragen. (Neue Aufl.) 30 Bde. Stuttgart. 1853, 1854. Hoffmann.

1. 'Der letzte Mohikan.' Engl. v. Leonh. Tafel.
2. 'Der Pfadfinder.' Engl. v. C. Kolb.
3. 'Die Ansiedler.' Engl. v. C. Kolb.
4. 'Die Prairie.' Engl. v. G. Friedenberg.
5. 'Der Lootse.' Engl. v. Ed. Mauch.
6. 'Der Spion.' Eine amerik. Erzählung. Engl. v. C. Kolb.
7. 'Lionel Lincoln.' Engl. v. Ed. Mauch.
8. 'Der rothe Freibeuter.' Engl. v. G. Friedenberg.
9. 'Die Beweinte von Wish-Ton-Wish.' Engl. v. G. Friedenberg.
10. 'Die Wassernixe.' Engl. v. G. Friedenberg.
11. 'Donna Mercedes von Castilien.' Engl. v. C. Kolb.
12. 'Der Wildtödter.'
13. 'Die beiden Admiräle.' Engl. v. Ed. Mauch.
14. 'Der Irrwisch.' Engl. v. Ed. Mauch.
15. 'Der Bravo.' Engl. v. G. Friedenberg.

16. 'Wyandotté oder das Blockhaus.' Engl. v. Ed. Mauch.
17. 'Ned Myers.'—'Die französische Erzieherin.'
18. 'Miles Wallingford's Abenteuer.' Engl. v. Ed. Mauch.
19. 'Lucy Hardinge.' Engl. v. C. Kolb.
20. 'Die Heidenmauer.' Engl. v. C. Kolb.
21. 'Die Heimkehr.' Engl. v. C. Kolb.
22. 'Eva Effingham, oder die Heimath.'
23. 'Der Scharfrichter, oder die Winzerabtei.'
24. 'Satanstoe, oder die Familie Littlepage.'
25. 'Der Kettenträger.'
26. 'Ravensnest, oder die Rothhäute.'
27. 'Mark's Riff oder der Krater.'
28. 'Kapitan Spike, oder die Golf-Inseln.'
29. 'Die Seelöwen, oder die verlorenen Robbenjäger.'
30. 'Der Bienenjäger, oder die Eichen-Lichtung.'

1862.—'Cooper's Lederstrump-Erzählungen.' Für die Jugend bearb. Mit 6 Zeichnungen v. Bartsch. 2. Aufl. Berlin, 1864. 4. Aufl. Neu-Ruppin, 1868.

1866—'Cooper's Seegenmälde.' Für die Jugend bearb. 1, u. 2. Aufl. Berlin, 1866, 1869. Von. G. Bartsch.

1874.—'Lederstrumpf. Bilder u. Scenen aus dem fernen Westen.' Nach James Fenimore Cooper der reiferen Jugend erzählt von A. Hummel. Leipzig.

'Seegemälde.' Für d. Jugend bearb. v. Adam Stein. Leipzig.

1875.—'Der rothe Freibeuter.' Nach J. F. Cooper f. die reifere Jugend bearb. v. Otto Hoffmann. Stuttgart. 4. Aufl. 1891.

'Die Wassernixe od. das Schmugglerschiff.' Von Otto Hoffmann bearb. Stuttgart.

'Lederstrumpf-Erzählungen.' Für die Jugend bearb. v. Adam Stein. Leipzig.

'Mark's Riff od. der Krater.' Eine Erzählung aus dem stillen Weltmeere. Aus d. Engl. für die reifere Jugend bearb. v. Carl Wirth. Leipzig.

1876.—'Lederstrumpf Erzählungen.' Für die Jugend bearb. v. Frz. Hoffmann. Stuttgart.

1877.—'Lederstrumpf-Erzählungen.' Für die Jugend bearb. v. Fr. C. v. Wickede. Nürnberg.

'Der letzte Mohikan.' Deutsch v. Otto Randolf.—'Der Spion.' Deutsch v. Demselben. Beide in Reclam's Univ. Bibliothek. Leipzig. 1877-1882.

1878.—'Der Spion.' Von Frz. Hoffmann bearb. 2. Aufl. Leipzig.

1879.—'Der Lootse. Ein Seegemälde.' Für die reifere Jugend bearb. v. Otto Hoffmann. Stuttgart.

'Lionel Lincoln oder die Belagerung von Boston.' Von Frz. Hoffmann bearb. Teschen.

1880.—'Der rote Freibeuter.' Für die Jugend neu bearb. v. E. Trautmann. Stuttgart.

'Lederstrumpf-Geschichten.' Nach Cooper neu für die Jugend bearb. von Gust. Höcker. 1880-1882.

'Lederstrumpf-Erzählungen.' Für die Jugend bearb. v. Adam Stein. 15. u. 16. Aufl. Leipzig, 1880-1882. 20. Aufl. Leipzig, 1886. 22. Aufl. 1890.

1881.—'Der rote Freibeuter.' Für die reifere Jugend bearb. v. Fr. Hoffmann. Leipzig.

'Der Bravo.' Eine venetian. Geschichte v. Fenimore Cooper. Übers v. Helene Lobedan. 1881, 1882.

'Die Belagerung von Boston.' Von Frz. Hoffmann bearb. Esslingen.

'Mark's Riff.' Für die reifere Jugend bearb. 3. Aufl. Stuttgart.

1882.—'Lederstrumpf-Geschichten.' Für die Jugend bearb. v. Fr. Hoffmann. Berlin. Auch Berlin, 1885; 10. Aufl., Berlin, 1887.

1883.—'Cooper's Lederstrumpf-Erzählungen.' Für die Jugend bearb. v. Frz. Hoffmann. Mit 16 Stahlst. 11. Aufl. Stuttgart. Schmidt u. Spring. 12. Aufl., 1889.

'Mark's Riff.' Nach der Erzählg. v. J. F. Cooper für die Jugend bearb. v. M. Barack. In Universal-Bibliothek für die Jugend. Stuttgart. 1883-1886.

1884.—Cooper's 'Lederstrumpf-Erzählungen.' Für die Jugend bearb. von Fr. C. v. Wickede. 2. Aufl. Neue Ausg. Nürnberg. Neugebauer.

1886.—'Comanchet, der Indianerhäuptling.' Für die reifere Jugend v. Frz. Hoffman bearb. 6. Aufl. Stuttgart. 7. Aufl. 1895.

1887.—Cooper's 'Lederstrumpf-Erzählungen' in 1 Bd. Hrsg. v. J. H. Campe.

'Lederstrumpf-Erzählungen.' Der reiferen Jugend erwählt von A. Hummel. 4. Aufl. Leipzig.

1888.—'Lederstrumpf-Erzählungen.' Aus d. Engl. v. C. Kolb, G. Friedenberg, L. Tafel. Neue durchgeseh. Ausg. in 5 Bdn. Berlin.

'Der Wildtöter.' Eine Erzählg. f. d. Jugend frei bearb. v. P. Moritz. Stuttgart. Thienemann. 2 Aufl. 1895.

'Der Wildtöter.'—'Der letzte Mohikaner.' F. d. deutsche Jugend bearb. v. O. Berger. Reutlingen.

'Der letzte Mohikaner.' Eine Erzählg. aus dem J. 1757. Berlin.

'In Bibliothek interessanter Erzählungen.' Mühlheim. 1887-1889. Bagel.

'Die Ansiedler;' 'Der Letzte der Mohikaner;' 'Der Pfadfinder;' 'Der Wildsteller;' 'Der Wildtödter.' Alle bearb. v. Carl Zastrow.

'Der letzte Mohikaner.' Bearb. v. A. Helms. Leipzig.

'Dassalbe,' hrsg. v. Thdr. Weyler. Leipzig. 1887-1889.

1889.—'Lederstrumpf-Geschichten.' Für die Jugend bearb. v. E. Schmidt. Berlin.

'Der Pfadfinder, Lederstrumpf, Die Ansiedler, Der Wildsteller, und 'Die Prairie.' in 1 Bd. Reutlingen.

'Der Letzte der Mohikaner.' Dresden, 1888-1889.

'Dasselbe,' frei bearb. v. P. Moritz. Stuttgart.

1890.—'Der Letzte der Mohikaner.' Bearb. v. O. Heinrichs. Prachtausgabe. Münster. 2. duchgeseh. Aufl., 1899; 3. Aufl., 1909.

'Lederstrumpf oder die Ansiedler.'—'Der Pfadfinder.' Beide für die Jugend frei Bearb. v. Moritz. Stuttgart. Thienemann.

'Der Pfadfinder.' 2. Aufl., 1895.

1891.—'Die Ansiedler an den Quellen d. Susquehannah.' Für die deutsche Jugend bearb., sowie m. Einleitg. u. Erläutergn. versehen v. O. Heinrichs.

In 'Aschendorff's Prachtausgaben wertvoller Jugendschriften.' Münster i. W.

'Der letzte Mohikaner.' F. d. Deutsche Jugend bearb. v. O. Heinrichs. In ausgewählte Volks- und Jugendschriften. Münster i. W.

'Comanchet od. die Ansiedler in Connecticut.' Der reiferen Jugend erzählt v. Ferd. Braun. Leipzig.

'Lederstrumpf.' Fünf Erzählgn., für die liebe Jugend frei bearb. v. Osk. Höcker. Stuttgart. 1891-1894. 7. Aufl., 1896: 10. Aufl., 1903; 12. Aufl., 1908; 13. Aufl., 1911.

'Der Wildsteller od. die Prairie.' Eine Erzählg. f. die Jugend frei bearb. v. Paul Moritz. Stuttgart. 2. Aufl., 1896.

'Waldläufer- u. Lederstrumpf-Erzählungen.' Für d. liebe Jugend hrsg. v. P. Moritz u. O. Höcker. Stuttgart.

'Lederstrumpf-Erzählungen.' Für die Jugend bearb. v. Paul Moritz. Gesant-Ausg. Stuttgart. 2. Aufl., Stuttgart. 3. Aufl., 1900; 5 Aufl., 1907.

1892—'Die Prairie.' Für d. deutsche Jugend bearb. v. O. Heinrichs. In 'Aschendorff's Prachtausgaben wertvoller Jugendschriften.' Münster i. W.

'Die Ansiedler an den Quellen d. Susquehanna.' Für d. deutsche Jugend bearb., sowie m. Einleitg. u. Erläutergn. versehen v. O. Heinrichs. In Ausgewählte Volks- u. Jugendschriften. Münster i. W.

'Der letzte Mohikaner. Aus den Lederstrumpf-Erzählgn.' Für die Jugend bearb. v. Fr. C. v. Wickede. Stuttgart. 2. Aufl. Reutlingen. 1901.

'Der Wildtöter. Aus d. Lederstrumpf-Erzählgn.' Für die Jugend bearb. v. Fr. C. v. Wickede. Stuttgart.

1893.—In 'Bibliothek interessanter Erzählungen.' Mülhein a. d. Ruhr.

'Der Letzte der Mohikaner.'—'Der Wildtöter.'—'Der Pfadfinder.'—'Die Ansiedler.'—'Der Wildsteller.' Alle Bearb. v. Carl Zastrow.

'Falkenauge od. die grosse Schlange der Delawaren.' Erzählung aus der Zeit der englisch-französ. Kolonialkriege in Nordamerika. Für die Jugend erzählt v. C. Molli. Berlin.

'Unkas, der letzte Häuptling der Mohikaner.' Eine Erzählng. aus den Urwäldern Amerikas. Für d. Jugend bearb. v. C. Molli. Berlin.

'Lederstrumpf-Erzählungen.' Für die Jugend neu bearb. v. G. Grillenberger.

'Lederstrumpf-Geschichten.' Für die Jugend bearb. v. Br. Hoffmann. 8. Aufl. Leipzig.

'Der Letzte der Mohikaner. Eine Indianer-Geschichte.' Lpz. Gressner u. Schramm.

'Kapitän Spike od. die Golfinseln.' Für d. deutsche Jugend bearb. v. Max Barack. In Universal-Bibliothek f. d. Jugend. Stuttgart

1894.—'Der rote Freibeuter.' Nach Coopers gleichnam. Seeroman f. d. reifere Jugend bearb. v. Paul Osk. Höcker. Stuttgart. 2. Aufl., 1896; 3. Aufl., 1901; 4. Aufl., 1907.

'Lederstrumpf od. die Ansiedler.'—'Der letzte Mohikaner.' Beide bearb. v. Paul Moritz. 2. Aufl. Stuttgart. 4. Aufl., 1903.

1895.—'Der Bienenjäger od. d. Eichenlichtungen.' Für d. Jugend bearb. v. Gust. Höcker. In Universal-Bibliothek f. d. Jugend. Stuttgart.

1896.—'Das Blockhaus.' Erzählgn. aus d. nordamerikan. Befreiungskriege. Nach J. F. Cooper's Roman Wyandotté, frei f. d. Jugend bearb. v. Gust. Höcker. Stuttgart.

'Lederstrumpf-Erzählungen.' F. d. Jug. frei bearb. v. Benno Seeman. Dresden.

'Der letzte Mohikaner.' Nach d. engl. Original f. d. deutsche Jug. Bearb. Lpz.

'Der Spion.' Frei n. Cooper f. d. Jugend bearb. v. G. Benseler. Lpz. 6. Aufl., 1907.

'Der Wildtöter od. d. erste Kriegspfad.' Nach d. engl. Original f. d deutsche Jugend bearb. Lpz.

1897.—'Waldläufer- u. Lederstrumpf-Erzählungen.' Nach G. Ferry u. J. F. Cooper f. d. Jugend frei bearb. v. Paul Moritz u. O. Höcker.

'Ledestrumpf od. d. Ansiedler a. Otsego-See.' N. d. engl. Original f. d. deutsche Jugend bearb. v. Frdr. Meister. Lpz. Auch Pracht- u. Volksausgaben. 2. Aufl. Lpz. 1900. 4. Aufl. 1904.

'Im Lande d. Rothäute. Der Letzte d. Mohikaner,' v. J. F. Cooper.

'Der Waldläufer,' v. Gabr. Ferry. Mülheim a. d. R.

'Der Pfadfinder od. das Binnenmeer.' N. d. engl. Orig. f. die deutsche Jugend bearb. v. Frdr. Meister. Lpz. 4. Aufl., 1907.

1898.—'Der rote Seeräuber.' Der reiferen Jugend erzählt v. Frz. Hoffmann. 3. Aufl. Stuttgart.

'Lederstrumpf.' Drei Erzählgn. a. d. Indianerleben, f. d. Jugend neu bearb. v. Ernst Treuberg. Fürth.

'Lederstrumpfs Indianer-Geschichten.' Für d. Jugend frei nach Cooper dargest. 37.-42. Tausend. Wesel.

'Der Wildtöter.' Erzählung. Für d. Jugend neu bearb. v. Pet. Schlicht. Lpz. 2. Aufl. Lpz. 1899.

1899.—'Der Bienenjäger.' Eine Erzählg. aus der Wildniss Nordamerikas. Frei Bearb. v. Herm. Ferschke. Stuttgart.

'Der rote Freibeuter.' Für die reifere Jugend neu Bearb. v. Stier. Lpz. 2. [Titel-] Aufl. 1902.

'Lederstrumpf od. Die Ansiedler.' Frei bearb. v. Paul Moritz. 3. Aufl. Stuttgart.

'Lederstrumpf-Erzählungen.' Für die Jugend bearb. v. F. Hoffmann. Berlin. Auch Berlin, 1902.

'Dasselbe.' Für d. Jugend neu bearb. v. Klaus Bernhard. Stuttgart.

'Dasselbe.' Bearb. v. Frdr. Meister. 2. u. 3. Pracht- u. Volksausgaben. Lpz. 1899, 1901.

'Der letzte Mohikaner.' Erzählung. Für d. Jugend neu bearb. v. Pet. Schlicht. Lpz. 2. [Titel-] Aufl. 1901.

'Der letzte Mohikaner.'—'Der Wildtöter.' Beide aus d. Engl. v. L Tafel. In 'Amerikanische Romane.' Stuttgart.

1900.—'Der Letzte der Mohikaner.' Für die deutsche Jugend bearb. v. Frdr. Meister. 2. Aufl. Lpz.

'Der Wildtöter od. der erste Kriegspfad.' Für d. deutsche Jugend bearb. v. Frdr. Meister. 2. Aufl. Lpz. 4. Aufl. 1905.

'Lederstrumpf-Erzählungen.' Stuttgarter Orig.-Ausg. aus d. Engl. v. L. Tafel, neu durchgesehen v. K. Walther. Stuttgart.

'Der Pfadfinder.' Neu bearb. v. A. Stier. Lpz. 2. Aufl. 1903.

1901—'Der Pfadfinder.' Eine Erzählg. Frei Bearb. v. Paul Moritz. 3. Aufl. Stuttgart.

'Der Wildtöter.' Eine Erzählg. f. d. Jugend. Frei bearb. v. Paul Moritz. 3. Aufl. Stuttgart.

'Der Pfadfinder od. das Binnenmeer.' Bearb. v. Frdr. Meister. Lpz. 3. Aufl. 1903.

'Der alte Trapper.' Nach dem engl. Original v. Frdr. Meister. 2. Aufl. Lpz. 3. Aufl., 1903; 4 Aufl., 1907.

'Der Wildtöter.' Aus den Lederstrumpf-Erzählgn. Für die Jugend bearb. v. Fr. C. v. Wickede. Reutlingen.

1902—'Lederstrumpf od. Die Ansiedler.' Erzählung. Für d. reifere Jugend neu bearb. v. A. Stier. Lpz. 2. [Titel-] Aufl. Lpz. 1905.

'Lederstrumpf-Erzählungen.' Neu bearb. v. Wilh. v. Beck. Berlin.

'Der Letzte der Mohikaner.' Bearb. v. Friedr. Meister. 3. Aufl. Lpz. 4. Aufl, 1905.

1903.—'Lederstrumpf-Erzählungen.' 5 Bde. Nürnberg.

'Ledenstrumpf-Geschichten.' Für d. deutsche Jugend bearb. v. Frdr. Meister. Volks-Ausg. 4. Aufl. Lpz. 5. Aufl. 1907.

'Dasselbe in 5 Bdn.' Unter Mitwirk. v. Münchgesang f. die Jugend neu bearb. v. Osk. Hoffmann. Stuttgart.

1904.—'Falkenauge.' Für die Jugend bearb. u. m. Berücksicht. der neuen Rechtschreibung hrsg. v. Geo. Reichard. Berlin.

'Ledenstrumpf.' Für die Jugend bearb. u. m. Berücksicht. der neuen Rechtschreibung hrsg. v. Geo. Reichard. Berlin.

'Indianer u. See-Geschichten.' Für d. Jugend frei nach Cooper u. anderen erzählt. v. W. Fricke. Wesel.

'Lederstrumpfs Indianer-Geschichten.' Für die Jugend frei nach Cooper dargestellt. 50.-59. Taus. Neue Ausg. Wesel.

'Der Wildsteller.' Bearb. m. Berücksicht. der neuen Rechtschreibung hrsg. v. Geo. Reichard. Berlin.

1905.—'Comanchet, der Häuptling der Wampanowys.' Bearb. v. Karl Zastrow in 'Zwei Helden des Indianervolkes.' Mülheim a. d. R.

In 'Schaffstein's Volksbücher f. d. Jugend.' Köln, 1905, 1906.

Cooper's 'Lederstrumpferzählungen.' Für die reifere Jugend bearb. v. Wilh. Spohr.—'Der Wildtöter.'—'Der letzte Mohikan.'—'Der Pfadfinder.'—'Die beiden Seelöwen.'—'Der Letzte der Mohikaner.' Im 'Lande der Rothäute.' Mülheim a. d. R.

1906.—'Lederstrumpf-Erzählungen.' Für die Jugend bearb. Globus Verlag. Berlin.

1907.—'Der Bienenjäger.' Nach Cooper. Für die reifere Jugend bearb. v. G. Mensch. 4 Aufl. In 'Spiegelbilder aus dem Leben u. der Geschichte der Völker. Einbeck.

'Der rote Freibeuter.' Mit Vorbemerkg. u. dem Bilde des Verf. Nr. 2050-55 in 'Der Bibliothek der Gesamtliteratur des In- u. Auslandes.' Halle. 1907-1910.

'Schaffstein's Volksbücher: Die Ansiedler.'—'Die Prairie.' Köln.

'Lederstrumpf-Erzählungen.' Bearb. v. Klaus Berhard. 4. Aufl. Stuttgart.

'Die Wassernixe.' Nr. 8 in 1001 Erzählungen für Jung u. Alt. Berlin, 1907, 1908.

1908.—'Der Spion.' In 'Moderne Weltbücherei.' Magdeburg, Berlin.

'Der rote Freibeuter.' Bearb. v. Wilh. Spohr. Bd. 57 in 'Schaffstein's Volksbücher.' Köln.

1909.—'Lederstrumpf-Erzählungen' in der ursprünglichen Form. Übers. u. bearb. v. K. Federn. 5 Bde. Berlin, 1909, 1910. Luxus-Ausg. Ebd.

'Der Letzte der Mohikaner.' Aus d. Engl. v. Paul Seliger. In 'Meyer's 'Volksbücher.' Lpz.

'Der Wildtöter.' Nr. 67, 68 in 'Bunte Bücher.' Reutlingen, 1909-10.

'Fünf Lederstrumpf-Erzählungen.' Frei bearb. v. Osk. Höcker. Volksausg. Stuttgart.

1910.—'Ausgewählte Romane.' Übers. u. hrsg. v. Rich. Zoozmann. Mit einer Biographie u. e. Bildnisse des Dichters. Lpz. 1910, 1911. 1. 'Der Wildtöter.' 2. 'Der Letzte der Mohikaner.' 3. 'Der Pfadfinder.' 4. 'Die Ansiedler.' 5. 'Die Prärie.' 6. 'Der Spion, 'Der rote Freibeuter.' 7. 'Der Bravo.'

'Der rote Freibeuter.' In 'Von Buch zu Buch, von Blatt zu Blatt. Lpz. Cooper's 'Romane' neu erschienen, übersetzt v. Karl Federn. Verlag Cassirer. Berlin.

1911.—'Lederstrumpf od. Die Ansiedler.' Für d. Jugend bearb. Berlin. Globus-Verlag.

'Ned Myers.' Eine Seegeschichte. Frei bearb. v. A. Specht. Berlin.

'Der Letzte der Mohikaner.' Bearb. v. Otto Zimmermann. Bd. 9 in 'Die Bücher der deutschen Jugend.'

'Der Spion.' Für die Jugend bearb. v. Wilh. Spohr. Berlin.

The German translators seem to have translated largely from English editions of Cooper's novels This will explain a number of the above titles, which may seem unfamiliar to most American readers of Cooper. Thus 'Die Grenzbewohner, oder die Beweinte von Wisch-Ton-Wisch' is a translation of the title of the English edition, namely: 'The Borderers; or, the Wept of Wish-ton-Wish' (Amer. Ed. 'The Wept of Wish-ton-Wish'); 'Ausflüge (or Streifereien) in die Schweiz,' of 'Excursions in Switzerland' (Amer. Ed. 'Sketches of Switzerland'); 'Aufenthalt in Frankreich, Ausflug an den Rhein und zweiter Besuch in der Schweiz,' of the English title 'A Residence in France; with an Excursion up the Rhine, and a Second Visit to Switzerland' (Amer. Ed. 'Sketches of Switzerland.' Part Second); 'Erinnerungen an Europa,' of 'Recollections of Europe' (Amer. Ed. 'Gleanings in Europe'); 'Eng-

land. Mit Skizzen aus den Gesellschaften der Residenz,' of 'England; with Sketches of Society in the Metropolis' (Amer. Ed. 'Gleanings in Europe. England'); 'Wanderungen in Italien,' of 'Excursions in Italy' (Amer. Ed. 'Gleanings in Europe. Italy'); 'Evchen Effingham oder die Heimath,' of 'Eve Effingham; or Home' (Amer. Ed. 'Home as Found'); 'Der Irrwisch oder das Kaperschiff,' of 'The Jack o'Lantern (Le Feu-Follet); or the Privateer' (Amer. Ed. 'The Wing-and-Wing; or Le Feu Follet'); 'Die französische Erzieherin, oder das gestickte Taschentuch,' of the English title 'The French Governess; or the Embroidered Handkerchief' (Amer. Ed. 'Autobiography of a Pocket Handkerchief'); 'Lucy Hardinge,' of the English title 'Lucy Hardinge,' the second part of 'Afloat and Ashore,' known in America as 'Miles Wallingford'; 'Ravensnest, oder die Rothhäute von Ravens nest; or the Redskins' (Amer. Ed. 'The Redskins; or Indian and Injin'); 'Mark's Riff od. der Krater,' of the English title 'Mark's Reef; or the Crater' (Amer. Ed. 'The Crater; or Vulcan's Peak'); 'Capitän Spike oder die Golf-Inseln,' of 'Captain Spike; or the Islets of the Gulf' (Amer. Ed. 'The Islets of the Gulf; or Rose Budd'; also, 'Jack Tier; or the Florida Reefs'); 'Der Bienenjäger, oder die Eichen-Lichtungen,' of 'The Bee Hunter; or the Oak Openings' (Amer. Ed. 'The Oak Openings; or the Bee Hunter.')

Two works erroneously attributed to Cooper and listed under Cooper's works in Kayser's 'Lexikon,' are Catherine Sedgwick's 'Redwood' ('Redwood, ein amerikan. Roman von Cooper. 4 Thle. 1825,[29] and 'Mosely Hall' ('Mosely-Hall, oder die Wahl des Gatten. Roman von Cooper.' 3 Thle. Lpz. 1825). It is believed that the translator of these novels, J. P. E. Richter (pseudonym for Wilhelmine von Gersdorf), has translated other English novels which she wrongfully offered to the German reading public as works of Walter Scott. By some 'Mosely Hall' was looked upon as an unsuccessful novel, written in Cooper's youth.[30]

[29] Cf. 'Das literarische Conversations-Blatt.' 25. Januar, 1826.
[30] Cf. *Ibid.*, 6. Juli, 1826.

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INDIANA UNIVERSITY STUDIES

22. THE FLOOD OF 1913 IN THE LOWER WHITE RIVER REGION OF INDIANA. By Hal P. Bybee A.M., and Clyde A. Malott, A.B.

The 'University Studies' constitute a sub-series of the INDIANA UNIVERSITY BULLETIN *in which from time to time are published some of the contributions to knowledge made by instructors and advanced students of the University. At present not more than two or three such numbers are issued a year. The 'Studies' are continuously paged and numbered, and, as needed, a title-page and table of contents will be issued, for binding them up in volumes.*

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CORRECTIONS

Page 107, table of contents, ''Cause of Floods in the Ohio Valley,'' for ''135'' read ''134.'' In the same way for each succeeding topic to ''Summary of Damage to Soil'' the pages should read ''137,'' ,''138'', ''140'', ''140'', ''142'', ''142'' ''144'', ''144'' and ''145'' respectively.

Page 111, 8th line from the bottom, for ''4'' read ''5''.

Page 123, end of first paragraph, add ''page 168''.

Page 142, 14th line from the bottom, for ''15'' read ''14''.

Page 145, 1st line, for ''3'' read ''4''.

Opposite page 168, add''chart No. 6'' to the chart.

Page 173, in last paragraph, after ''C'' in the 12th line from the bottom add ''page 115.''

Opposite page 174, on the chart, for ''7'' read ''8''.

Opposite page 176, on the chart, for ''8'' read ''9'' and for ''7'' read ''8''.

Page 178, 16th line from bottom for ''2'' read ''3''.

Page 179, 1st and 22nd lines for ''2'' read ''3''.

Page 180, last line, for ''3'' read ''4''.

Page 181, 2nd line from the bottom, for ''4'' read ''5.''

Page 182, 3d and 6th lines from the bottom, for ''5'' read ''6''.

Page 184, last line, for ''Martin'' read ''Morgan.''

Page 189, last line, for ''3'' read ''4''.

Page 192, cancel ''(See figure 47.)''

INDIANA UNIVERSITY STUDIES

No. 22 BLOOMINGTON, INDIANA OCTOBER, 1914

Prefatory Note

It was realized that a thorough study of the flood of March, 1913, was necessary in order to determine the actual conditions and the consequences of it. The matter was called to the attention of the President of the University and an appropriation of $150.00 was made for the purpose, as a part of the Public Service Work of the institution.

Mr. Hal P. Bybee was placed in charge of a party consisting of Mr. Clyde A. Malott and Mr. Thomas F. Jackson. Mr. Jackson left the party at Worthington, on account of illness, and Mr. W. R. Allen took his place. On account of their accessibility, the two forks of White River were chosen for study. As soon as physical conditions would permit, the party took the field and the work was carried on under the most trying conditions.

The report which follows is the joint collaboration of Mr. Bybee and Mr. Malott, and forms the first accurate record of a great flood in the area studied, together with a discussion of the actual conditions found, and the precautionary measures that may be taken.

J. W. BEEDE,
Associate Professor of Geology.

Accepted for publication in the INDIANA UNIVERSITY STUDIES.
SAMUEL B. HARDING,
WILL D. HOWE,
ARTHUR L. FOLEY,
Committee.

Table of Contents

The Flood of 1913 in the Lower White River Region of Indiana

By Hal P. Bybee, A.M., and Clyde A. Malott, A.B.

PART I. INTRODUCTION

Acknowledgements

The recent March flood in the Ohio Valley brought such disaster and ruin upon the people within its scope that it will be long remembered, and will be used as a guage for floods of the future, whether of this particular region or elsewhere in the Mississippi Valley. Realizing this, the Department of Geology of Indiana University sent out an expedition as a part of the Public Service work of the University, to study the effects of the flood along the West Fork of White River. The field work was done mainly by the writers, each of whom traversed a bank of the stream, carefully noting the conditions under which any damage was done. Much aid was given by Mr. Thomas F. Jackson, a graduate student in the Department of Geology, who took charge of the boat and noted changes that took place in inaccessible places. To Mr. Jackson, credit is due for preparing the photographs. The writers are indebted to Dr. J. W. Beede for his valuable suggestions and general supervision of the work. Dr. E. R. Cumings has given much valuable criticism and has aided the writers greatly by his suggestions. The photographs of the region below the junction of the two White Rivers were contributed by Mr. Harry W. Morrison, county surveyor and engineer of Gibson County.

It was almost three weeks after the crest of the flood had passed before the flood plain was dry enough to permit the work to be undertaken. On April 19, the party started at Waverly, near where the river enters Morgan County. Some three weeks were required to traverse the river valley through Morgan, Owen, Greene, and between Knox and Daviess counties, to the junction with the East Fork of the White River. At Worthington, in Greene County, Mr. Jackson was succeeded by Mr. W. Raymond Allen, a graduate student of the Department of Zoölogy of Indiana University.

After the party had traversed the West Fork from Waverly to the junction with the East Fork, a distance of about 200 miles by the river, it was found that the funds which were furnished for the expedition by the University were sufficient to cover the expenses of an investigation of a considerable portion of the East Fork of White River. Accordingly, the equipment was shipped to Brownstown, near the middle of Jackson County. Two weeks were consumed in the investigation of the East Fork from Brownstown through one-half of Jackson, Lawrence, and part of Martin Counties to Shoals, making a distance of about 110 miles along the East Fork. Thus, five weeks were spent on the expedition, and about 310 miles of river bottom traversed.

Since a flood of the magnitude of the recent one does not occur more than once or twice in a generation, it was not known just what was to be found or what were the most important phases of the situation. In a very short time, however, the following things revealed their need of consideration:

1. Effect of bridges, both highway and railroad, upon the height of the water.
2. Railroad grades and public road grades.
3. Bank cutting, amount, causes and prevention.
4. Deposits of sand, silt and gravel.
5. Removal of the top soil.
6. Cutting of holes, causes, and prevention.
7. Effects of meanders.
8. Levees, their good points and their bad points.
9. Effect on the future crops, and the destruction of wheat and corn.
10. Damage to cities, towns, and villages, and to farm improvements.

Valuable aid was given by the farmers along the river bottom in the consideration of the above items. As far as possible each farmer was questioned about the March flood and his opinion procured as to damage. Since soil was the main physical loss to the valley land, farmers were questioned on every possible occasion as to their ideas of the damage to future crops on account of the removal of the top soil. The effect of grades, both of public roads and railroads, was discussed with those affected.

Lack of Good Base Maps

One of the most serious handicaps that was encountered in doing the work in a first-class manner was the lack of a good base map with which to work. The soil and county maps that were available were far from being accurate in geographic detail; and thus it was almost impossible to note the lesser changes made by the high water. It is the little changes that are taking place from year to year, that in the end make the greatest change, or lead up to some marked change in the course of a stream. There are several places where as much as three acres are lost each year. It was not uncommon for as much as forty acres to have been lost in the short time of ten years. This is the case at the first bend in the river after it turns south at Spencer. Again in twenty-seven years, twenty acres have been lost from the John Duke farm, between Worthington and Bloomfield. These changes and hundreds of others are taking place all the time and in a few years make a considerable change in river channel. Without the aid of topographic maps it is impossible to note these changes.

If a complete topographic map of the White River bottom were available, a study of the situation could be made and the advisability of a system of levees for any part of the river bottom could be worked out. As it is, nothing but an expensive survey of the entire bottom will show the advisability of such a system. When such a survey was finished, there would be nothing that could be used later for any other specific purpose; while the same amount of money with a little more added to it would make a permanent topographic map that could be used in making a complete study of the entire situation. With such a map having a ten foot contour interval, the geology and physical features of the river valley could be worked out. The advisability of making cut-offs, thus shortening the stream, and even the approximate cost of such work could then be determined. For instance, at Bloomfield, just below the Illinois Central Railroad, the river makes a long loop to the south, as seen in Chart No. 4. At the southern end of the loop a new channel less than a third of a mile in length would shorten the course of the river over a mile. With a good base map to work from, the position of the proposed cut-off could be determined at a place where there would be the least possible bank cutting and the most land reclaimed by such a cut-off. A close study of a topographic map would furnish an engineering corps with sufficient data to work from. That is, they would

know what they were to find and the easiest and least expensive manner of procedure.

The Mississippi River Commission started its work by having made a large scale contour map of the entire lower course of the Mississippi River. With this base map to work from, other surveys have been made, and the entire lower course of the Mississippi River has been brought under almost complete control. Not only could the topographic maps be used in the study of the flood situation, but they could be used in the study of the improvement of the public roads in the unglaciated part of the State. By looking at the contour map of the Bloomington Quadrangle, it will be seen that the roads are built on the section lines, in a good many instances making the road so hilly as to prevent the marketing of the crops, and making heavy hauling almost impossible. These roads could be built around hills of excessive steepness and height, in many cases, where they are now built on the section line directly over the hill. Also the location of road metal quarries could be made in the best possible location with respect to applying the metal to the road.

The possibilities of storing the excess flood waters in the lake region of the northern part of the State for irrigation and power purposes could be worked out in a definite manner by the aid of adequate topographic base maps.

It would be well to place topographic maps in the public schools, for social as well as physical problems may be studied by their use. An example of the social problems that may be studied by the aid of the contour map is found in the following question: 'Can the people that live on the part of the river valley that is frequently overflowed move to higher locations?' Or, 'Are they a poorer class of people that are not financially able to make such a move? Are they renters or do they own their own homes? Could these low lying districts be turned into public parks which would not be seriously damaged by the overflow of the stream?'

The estimated damage to soil on the part of the White River bottom traversed was something near $250,000. The cost of making a map of a fifteen minute quadrangle varies from $1,350 to $5,750, according to the nature of the topography, or from $6 to $25 per square mile. At the lesser figure, the entire drainage area of both forks of White River could be mapped for $75,000. Putting the cost at $2,500 for each quadrangle, the entire drainage of both forks of White River could be mapped for $132,000, or about one-

half the estimated loss to soil in the recent flood. For the estimated loss of soil, the whole State could be mapped. About fifteen fifteen-minute quadrangles would cover the greater part of the valley land on both forks of White River and would cost less than one-third of the estimated damage to soil in the recent flood. These figures are possibly too high, for the relief in Indiana is not very pronounced, especially in the glaciated part of the State.

General Laws of a Stream

In the work of water, as it is emphasized along any stream from a mere rivulet to a great river, a few principal laws come under consideration which are applied to any particular stream. Since these laws are fundamental, a few pages are here devoted to a consideration of them.

'Every river appears to consist of a main trunk, fed from a variety of branches, each running in a valley proportional to its size, and all of them together forming a system of valleys communicating with one another, and having such a nice adjustment to their declivities that none of them join the principal valley either at too high or too low a level, a circumstance which would be infinitely improbable if each of these valleys were not the work of the stream flowing in them.' (John Playfair, 'Huttonian Theory of the Earth.')

Streams are one of the most important agencies that give form and expression to the surface of the earth; they are the principal factors in fashioning the details of the various topographic forms that strike the eye of the every-day observer. Streams cut into the plains, making valleys and hills suited to the size of the streams and proportioned to the general elevation of the former plain above the mouths of the main streams.

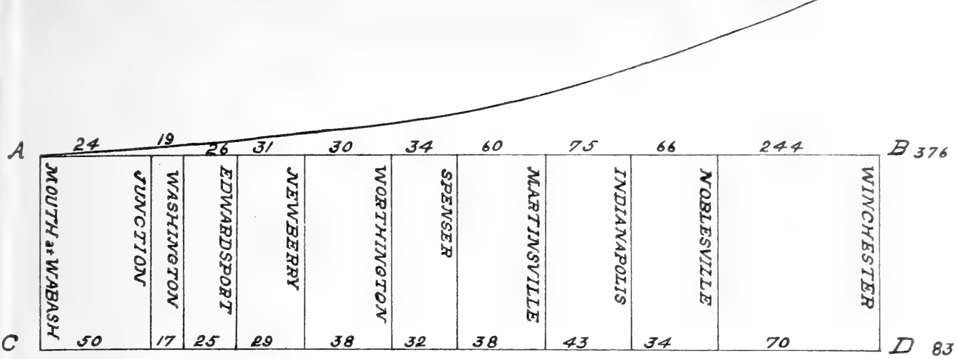
Every one is aware that streams carry sediment, and especially after rains during high water. When one considers that streams, ever and ever, are carrying sediment, he soon is able to grasp the idea how streams are able to carve the surface of the earth as they do. During each high water millions and millions of tons of sediment are carried to the ocean. Nearly every one has noticed that during the short summer shower a considerable gully may be made on a hill side, that started from a little rill in the mark of a harrow tooth. The soil thus removed, however, may be at the foot of the same hill. In fact the soil from the source of a stream may make many stops before it finally reaches the ocean.

It may lay in the form of alluvial material for centuries before it is removed to its final resting place in the ocean. A summary of the denudational processes in the United States is given in 'Water Supply Paper No. 234,' by Dole and Stabler. The last paragraph is as follows:

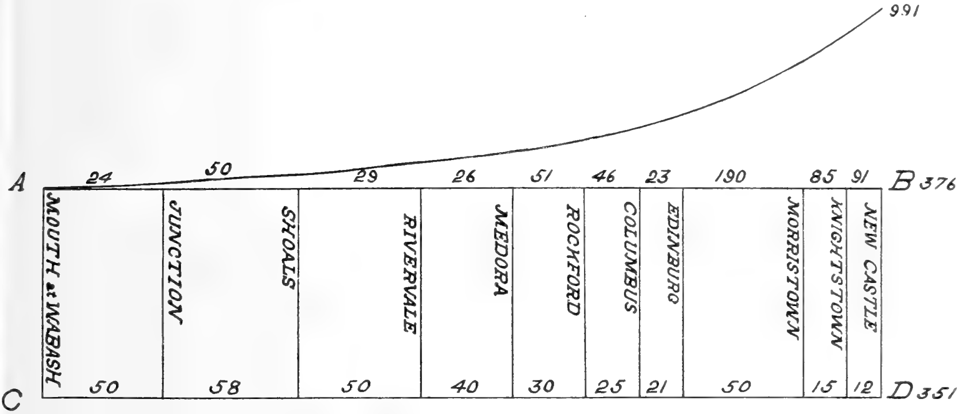
> The estimates reveal that the surface of the United States is being removed at the rate of thirteen ten-thousandths of an inch per year, or one inch in 760 years. Though this amount seems trivial, when spread over the surface of the country, it becomes stupendous when considered as a whole, for over 270,000,000 tons of dissolved matter and 513,000,000 tons of suspended matter are transported to tide water every year by the rivers of the United States. This total of 783,000,000 tons represents more than 350,000,000 cubic yards of rock substance, or 610,000,000 cubic yards of surface soil. If this erosive action had been concentrated upon the Isthmus of Panama at the time of American occupation, it would have excavated the prism for an eighty-five foot sea level canal in about seventy-three days.

It has been shown by Humphreys and Abbott that the Mississippi River alone transports enough sediment to tide-water in one year to build up a tract of swamp land 268 square miles in area one foot in depth. There has been no consistent effort toward using this enormous quantity of sediment that the rivers of the United States carry to the ocean, and as a result all of this good soil is lost. In the case of the Mississippi River, the sediment might be used to build up some of the vast areas of swamp land along its lower course, so that something besides malaria might be produced where the swamps now are.

The manner in which material is acquired by running water, the way in which it is carried, the effect it has on the bottom and sides of a stream, and how it modifies the flood plain in times of flood can be ascertained by the careful study of a single stream. We think, ordinarily, that the function of a stream is to carry away the stupendous amount of flood water and the general run-off, while in reality its purpose is that of leveling. Salisbury says the purpose of a stream is to carry the lithosphere into the hydrosphere. The term 'leveling' may seem contradictory to the previous statement that streams make hills and valleys; but leveling is their function in that they reduce, very slowly to be sure, the land to sea level, or approaching it. They etch their way into the plains and cut them into hills and valleys and these hills are in turn worn to a base level. No one person can live long enough to see the life history of any one stream completed, but the physiographer sees many examples of streams representing all stages between youth and old age. He may see stages in which the stream has all of its



PROFILE: WEST FORK OF WHITE RIVER



PROFILE: EAST FORK OF WHITE RIVER

DIAGRAM No. 1.

Figures along the tops of the two diagrams, A to B, are fall in river from one town to the next one mentioned.

Figures along the bottoms of diagrams, C to D, represent distance in miles from one town to the next one mentioned.

Figures at right end of curve show elevation of river at Winchester and New Castle above sea level.

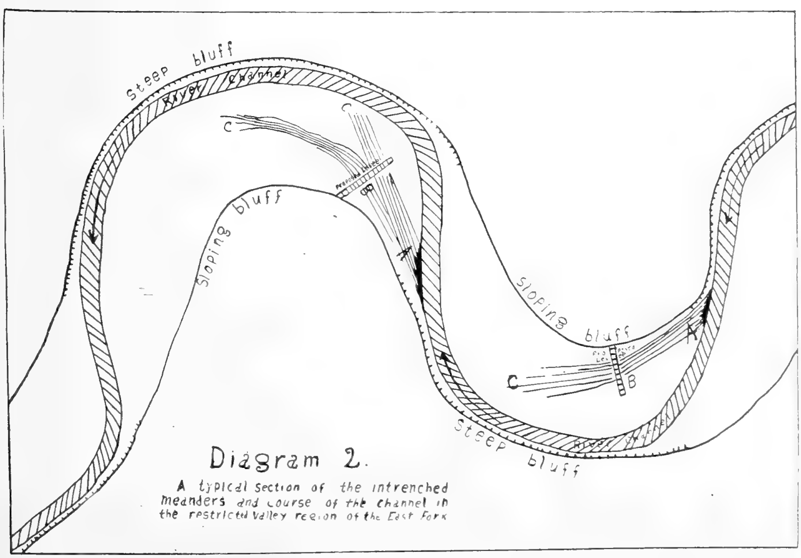


Diagram 2.

A typical section of the intrenched meanders and course of the channel in the restricted valley region of the East Fork

work before it; that is, there is still a great amount of upland. The streams in this case are small, usually straight, swift, heavily loaded with sediment, and characterized by falls and rapids. A stream with these characteristics is termed a young stream. He may see stages in which the work is half completed; that is, in maturity, in which the plain is so cut up that it is all ridges and valleys. He may see stages in which the work is almost finished; that is, in old age, in which the valleys are wide; the streams have many meanders; a few monadnocks rise above the general relief; and the stream is sluggish, and is building up its lower course instead of lowering it. These, in a few words, are the charactertistics of streams in the three stages of youth, maturity and old age.

If the general leveling of the land is the function of a stream, then we must next see how and in what manner it does this. As the rain falls it beats on the ground and gathers particles of soil; then, uniting into small rivulets, flows away in response to the force of gravity. These little rills, turbid with sediment held in suspension, unite into brooks, and these in turn combine to form larger streams, which are also turbid. The particles held in suspension have a tendency to fall to the bottom, but are kept up by the various upward currents that are to be found in flowing water, due to the unevenness of the bed of the streams, or to rocks or other debris on the bottom. The sediment may rest on the bottom for a time, but it will be gathered up and carried on down stream and will finally arrive at its resting place in the ocean.

Not only is the sediment gathered up by the little rills, but the main stream is constantly widening and often deepening its channel. This process also furnishes another source for the derivation of sediment. For instance, the Mississippi River carries into the Gulf more sediment than the tributaries bring into the main stream. (Dole and Stabler, 'Water Supply Paper, 234.')

The ability of a stream to carry sediment depends upon the velocity, the volume, the nature of the material to be carried, and the presence of upward and cross currents. Any one who has observed a stream knows that the velocity is not continuously the same, and that the velocity is less at the sides than at the middle, and less on the bottom than on the surface. The thread of swiftest flow is ordinarily in the center of the stream and about one-third of the distance from the surface to the bottom. (I. C. Russell, 'Rivers of North America.') The bottom of the current is held back by the friction on the bed, and the surface by the friction of the air. If the stream is heavily loaded, the highest per cent of

sediment is found where the current is less—that is, near the bottom, surface, and sides of the stream.

Another class of debris that is carried by a stream in times of flood includes tree trunks, logs, rails, bridge planks, boards, telephone poles, and everything that will float or that can be held up by the current. These things cause much damage in that they have a tendency to form a dam whenever they may become lodged. In this way many bridges are washed away. The road west of Martinsville was damaged to a great extent by the cross currents set up by the debris catching on the wire fence on the north side of the road and forming a dam. L. C. Glenn, in 'Professional Paper No. 72, U. S. G. S,' cites many illustrations of mills and power plants having been destroyed by floating debris becoming lodged against them and finally forcing them from their foundations.

Geologic Structure of Indiana

Since the drainage of both forks of White River is closely associated with the geological structure, a brief discussion will be given at this time. The geologic history of the State is embraced by the Paleozoic times. The geological scale for Indiana is as follows:

Paleozoic	Pennsylvanian	Merom sandstone
		Coal measures
		Mansfield sandstone.
	Mississippian	Chester sandstone and limestone
		Mitchell limestone
		Oolitic limestone (Salem)
		Harrodsburg limestone
		Knobstone sandstone and shales
		Goniatite limestone.
	Devonian	New Albany black shale
		Sellersburg limestone
		Silver Creek limestone
		Jeffersonville limestone
	Silurian	Waterline
		Niagara limestone
		Clinton limestone.
	Ordovician	Richmond limestone and shales
		Lorraine limestone and shales
		Eden shales and limestones
		Trenton limestone.

The geologic history of Indiana begins with an old sea which gradually retreated to the southwest as the region to the northeast was raised. The general dip of the rocks is to the southwest, at the rate of twenty to thirty feet to the mile. In some places the dip is much more, at times, being as much as a hundred feet to the mile. Beginning with the Ordovician formations which are the oldest rocks found in Indiana, the other formations are exposed as one goes from east to west across the State, until the Merom sandstone is reached at the extreme western part of the State. In each case, the older passes under the younger, and each is exposed at the surface for a distance dependent upon the thickness of the formation and the amount of stream erosion.

Ordovician. The Ordovician rocks are the oldest rocks exposed in Indiana. They consist of a series of hardened clays and thin bedded limestones, commonly designated as the Cincinnati group. This region includes a strip from fifteen to twenty-five miles in width extending from the Ohio River northward to the northern part of Wayne County. The entire territory is drained by Whitewater River, and other streams that flow into the Ohio River. Since shales are easily eroded, the relief is rather pronounced, being as much as four hundred feet. The limestones of the region are very thin, rarely more than a few inches in thickness, thus affording very little protection to the shales. The region in general is one of the physiographic divisions of the State and may be called the Eastern Highland, the elevation above the sea being from 700 to 1,200 feet.

Silurian. The Clinton and the Niagara limestones of Silurian age succeed the Ordovician rocks. They are the surface rocks along the Ohio River, extending in a narrow strip northward through the eastern part of Clark County, the middle of Jefferson County, the eastern part of Jennings County, thence with the western limit near Greensburg and Rushville, northwest past Noblesville, as indicated on Chart No. 1. From Rushville south the outcrop will average fifteen miles in width, except at the extreme southern part. The Clinton limestone, which is basal Silurian in Indiana, is a rather thin bed, varying from a few inches to about seven feet in thickness. The Niagara group, which overlies the Clinton limestone, is composed of several divisions of limestone and shales, aggregating in all about one hundred and twenty-five feet, in the southern part of the State. To the north where the Niagara passes under the glacial drift, it reaches a thickness of four hundred feet. The topography of the Niagara limestone outcrop is rather

CHART No. 1. Geologic map of Indiana, showing width of the White River valleys in different formations.

FIG. 3. Hole where a haystack had been. In the background, a crew replacing the grade that was washed out on the east side of B. & O. bridge across White River, three and a half miles south of Bedford.

FIG. 4. A hole washed out at Summers ditch crossing, west side. Size of hole, 100 feet wide by 300 feet long by 30 feet deep.

rough, the steep slopes being the result of the predominating limestones, and is somewhat in contrast to the rounded hills of the Eastern Highland of southeastern Indiana. The general slope is to the west. The eastern rim of the Clinton and the Niagara is the dividing line between the White River and Whitewater River systems. The streams flow southwest down the dip of the rocks and the Niagara is exposed in the bed of the streams for several miles to the west of the general outcrop.

Devonian. The Devonian rocks succeed the Silurian, and may be grouped into two main divisions, the lower being limestones and the upper soft shales. The most important limestone is the Corniferious, or Jeffersonville, which is a rather hard bluish gray limestone, the combined strata averaging about sixty-five feet in thickness. To the north it seems to be partly replaced by the Geneva, a buff or brownish colored magnesian limestone. Above the Jeffersonville limestone, are two thin beds of limestone known as the Silver Creek and the Sellersburg. These outcrop in the extreme northern part of the region. On top of these limestones occur the New Albany Black Shales, which will average 125 feet in thickness. These shales are sulphurous and contain so much bitumen that they will burn when thrown on a fire. Weathering takes place very rapidly in these shales and as a result the region is worn down almost to base level. This region about New Albany, Scottsburg, Seymour, Columbus, and Franklin averages about 10 to 15 miles in width, and is known as the Eastern Lowland. It is from 500 to 700 feet above the sea. The East Fork of White River flows southward through this trough for many miles to Rockford in Jackson County, where it turns to the southwest, and flows through a gorge in the succeeding formations.

Mississippian. The Mississippian strata, in Indiana, occupy the middle portion of the southern half of the State, and next to the Pennsylvanian, are the most important rocks in the State. The Mississippian in Indiana is divided into six divisions, which aggregate over a thousand feet in thickness. These divisions will be treated in the order in which they occur, beginning with the Goniatite limestone, which is the oldest. The Goniatite limestone is unimportant, but is remarkable in its consistency in underlying the whole Mississippian system. It is generally less than six feet in thickness. The Knobstone group is composed of shale at the bottom, while near the middle are massive dark blue calcareous and clayey sandstones, and near the top is a light brownish sand-

stone intercalated with shaley layers. The Knobstone is between 400 and 600 feet in thickness. The area of outcrop is from twenty-five to thirty miles in width and extends from the Ohio River northward through Floyd County, western Clark, eastern Washington, western Scott, nearly the whole of Jackson, Brown, Morgan, Hendricks, and Montgomery Counties, passing under the glacial drift in Benton County. The topography of this region is the most rugged of any in the State. The Knobstone rocks absorb water readily, but being impervious, transmit it very poorly, so that these rocks are readily shattered by freezing and thawing. The region is weathered and eroded into steep-sided valleys, the bottoms of which are from 200 to 400 feet below the general level of the land. The topography of Brown County is a good example of these steep-sided valleys. Since the elevation of the region is from 700 to 1,100 feet above the sea, it is known as the Central Highland. The courses of both forks of White River are to the southwest directly across the Knobstone region. The valleys are from two to five miles in width and are bordered on either side by abrupt, bluish bluffs, ranging from 150 to 250 feet in height. Typical bluffs of this kind are to be found on the West Fork above Martinsville and on the East Fork at Brownstown and Sparksville.

The Harrodsburg limestone which overlies the Knobstone, is a coarsely crystalline, fossiliferous, hard, blue stone from 35 to 100 feet in thickness. Its outcrop is between a quarter of a mile and three miles in width. The topography is very similar to that of the succeeding formations.

The Salem limestone overlies the Harrodsburg limestone. It is a massive, oolitic, buff to bluish, fossiliferous limestone, known over the United States as one of the best building stones. The softness of the freshly quarried rock makes it very easily worked, and upon exposure to the air it gets hard and durable. The thickness of the Oolitic limestone varies from a few feet up to 90 feet.

The Mitchell limestone is a hard, fine grained fossiliferous, blue stone, having a thickness ranging from a few feet up to, possibly, 250 feet. This limestone is easily soluble and is pitted over its entire outcrop with sinks. The region of its outcrop is largely drained by underground channels. It is in this formation that some of the largest caves of the world are found. Some of the noted caves found in the Mitchell limestone are Mammoth Cave of Kentucky, and Wyandotte and Marengo Caves of Crawford County, Indiana. Lost River in Orange County is a typical underground stream for thirteen miles of its length. Green River, Kentucky, drains Mam-

moth Cave and is another example of the solubility of the Mitchell limestone. The Harrodsburg, Oolitic or Salem, and the Mitchell limestones are shown in Chart No. 1 as one formation. Through this limestone region both forks of White River narrow down to about a quarter of a mile in width. This narrowing of the valley in passing from the region of soft shales and sandstones to the hard limestones had remarkable effect on the flood conditions, as will be mentioned in another place.

The last division of the Mississippian is the Chester. This consists of a series of thin limestone, shales and sandstones, aggregating 190 feet in thickness. There are three thin limestones with sandstone and shales between.

Coal Measures. The Mansfield sandstone is a massive, coarse-grained sandstone and is the basal member of the coal measures in this State. On top of the Mansfield Sandstone is a series of shales, sandstones, coal seams, fire clays, and limestones. The shales make up the greater part of the coal measures. The Merom sandstone lies next above the coal measures. Mr. J. F. Newsom in the '26th Annual Report of the State Geologist,' says: 'Lying above the productive coal measures and separated from them by an unconformity is a sandstone with a thickness at Vincennes of from 40 to 50 feet. This sandstone has been known as the Merom sandstone, owing to its good exposures at the town of Merom. In general appearance it resembles the Mansfield sandstone, for which it has sometimes been mistaken. Whether it is of carboniferous, or later, age has not been satisfactorily determined.'

It is interesting to note that the size of the valley depends on the material through which the river flows. Above Gosport, on the West Fork, the river flows through the Knobstone region, which is composed of shales and thin bedded sandstones. These shales are easily eroded and as a result the valley is wide; being one to three miles in width. As the Limestone region is reached below Gosport, the valley narrows to between a quarter and three-quarters of a mile, until it leaves the Mansfield sandstone below Bloomfield, where it again widens even more than above Gosport. The same conditions are present on the East Fork. At Sparksville the wide valley narrows to a mile or less as it leaves the Knobstone region and enters the limestone area, and continues very narrow until it leaves the Mansfield sandstone at Shoals. Thus there is a remarkable constriction in the valleys of both forks where they flow through the limestone rocks and the more resistant Mansfield sandstone. It may be stated that House Rock and Jug Rock,

at Shoals, are in the Mansfield sandstone. As the valley becomes narrow, the depth of the water is increased and the amount of damage per acre is increased. At Romona, on the West Fork, the valley is about a quarter of a mile in width, and as a result the water during the flood was about thirty feet in depth on the valley, and the entire valley was swept clean (Fig. 1).

Drainage Area of White River

Both forks of White River rise near the highest point in the State, which is in Randolph County. This elevation is about 1,285 feet above sea level. The Mississinewa and the Whitewater Rivers also have their sources in this county. The East Fork rises in the very southwest corner of the county.

The West Fork flows in a westerly direction through Muncie, and Anderson, to Noblesville, then almost due south to Indianapolis. From Indianapolis it takes a direct southwesterly course to Petersburg. The West Fork flows through the Wisconsin glacial drift from its source to Martinsville, a distance of 125 miles, and in the Illinois glacial drift from Martinsville to the forks, a distance of 180 miles by the river.

The East Fork flows in a tortuous, winding manner, thus increasing its length and decreasing its fall by numerous meanders. The East Fork flows through the Wisconsin glacial drift from its source to Columbus, about 155 miles. Then in the Illinois drift from Columbus to Brownstown, a distance of 40 miles. From Brownstown it flows through the unglaciated part of the State for about 90 miles, and the last 40 miles are again in the Illinois glacial drift.

The writers have measured the drainage area of White River with a planimeter on a large scale map. ('Geologic Map of Indiana,' compiled by T. C. Hopkins, 1901–1903.) The areas were measured four times, with the following average results:

West Fork of White River	5,340 square miles.
East Fork of White River	5,580 square miles.
White River between the forks and Wabash	175 square miles.
Total drainage area	11,095 square miles.

TABLE No. 1—Profile of the West Fork of White River.[1]

Stations.	Distance Apart.	Distance from Noblesville.	Elevation.	Feet of Fall between Stations.	Fall per mile between Stations, in Feet.
Noblesville	0	0	741	0	0.0
Indianapolis	34	34	675	66	1.9
Martinsville	43	77	600	75	1.7
Spencer	38	115	540	60	1.6
Worthington	32	147	506	34	1.06
Newberry	38	185	476	30	0.8
Edwardsport	29	214	445	31	1.0
Washington	25	239	419	26	1.0
Junction	17	256	400	19	1.10
Mouth	50	306	376	24	0.45

Profile of East Fork.

Stations.	Distance Apart.	Distance from Morristown.	Elevation.	Fall Between Stations.	Fall per Mile Between Stations.
Morristown	0	0	741	0	0.0
Edinburg	50	50	625	116	2.3
Columbus	21	71	602	23	1.1
Rockford	25	96	556	46	1.8
Medora	30	126	505	51	1.7
Riverdale	40	166	479	26	0.65
Shoals	50	216	450	29	0.58
Junction	58	274	400	50	0.86
Mouth	50	324	376	24	0.45

[1] W. M. Tucker, Indiana Department of Geology and Natural Resources, 1910. The last two columns were added by the writers.

A study of the two profile tables shows a noticeably high fall at the source of the two streams, which rapidly decreases until Columbus is reached on the East Fork, and Noblesville on the West Fork. (Diagram No. 1 shows this very well.) The fall above Noblesville is between three and four feet to the mile. On the East Fork

the fall between Rivervale and Medora becomes as low as eight inches to the mile and between Rivervale and Shoals as low as seven inches to the mile. On the West Fork there is only one place where the fall goes below a foot to the mile, and that is between Worthington and Newberry, where the fall is a little less than ten inches to the mile.

Meteorological Conditions

Conditions for March 23–27, inclusive.[2] There is nothing to be found in a study of the weather maps of the period preceding the heavy rains that would indicate such conditions as caused the downpour that followed. The 'low' on Sunday night, March 23, 1913, overlaid southeastern Nebraska. On that day there were heavy rains from central Illinois to Western Ohio, over a strip of country probably 200 miles wide and 500 miles long, the focus of the heavy rains being in northeastern Indiana and northwestern Ohio.

Rain fell uninterruptedly over the above territory, Sunday night March 23. The amount of precipitation, however, was not so great as on the following day. In Illinois, on March 24, rain ceased, but the intensity over southern Indiana and southern Ohio increased and was greater than on the previous day. Here an important thing is to be noted: On March 23, the heaviest rainfall was on the head waters of the Wabash, White River, and the rivers of Ohio that flow into the Ohio River from the north; and on March 24, the heaviest rainfall had shifted to the lower parts of these rivers. This is a reversal of the ordinary conditions; for the ordinary storm moves from the lower part of these streams to the upper portions of their drainage areas, thus giving the water that first falls a chance to run away before the rainfall of the second period reaches it.

Monday night, March 24–25, brought a continuation of the rain over Illinois, Indiana, and northern Ohio. The same belt of heavy rain extended along the lower part of the Great Lakes down the St. Lawrence valley, into northern New England. As on the day before, the area of heaviest precipitation was in central Indiana and in central and northern Ohio during the daylight hours of March 25. It was the rainfall of this day, Tuesday, March 25, with its average of 4.46 inches of rain at sixteen out of the twenty stations in the White River drainage area, that sent the streams of central Indiana on their mission of unprecedented destruction.

[2] *Monthly Weather Review*, March, 1913.

The position of the 'highs' and the 'lows' during the period of March 23–27, is responsible for the continuation of the excessive downpour in the Ohio Valley. As nearly as possible, the following is the succession of events that caused the continuous downpour: In advance of the first storm, that formed on the 22nd and centered in the lake district on the morning of the 24th, a great bank of high pressure moved across the United States and settled in and over the Bermudas, remaining there until the 27th. Thus while the second storm was pushing eastward on the 24th, an area of high pressure existed off the Atlantic coast, and another area of high pressure existed north of the Great Lakes, and was spreading eastward. On the evening of March 24th, the two areas of high pressure were separated only by a long narrow trough extending northeast by southwest across the Ohio Valley. This trough connected the receding storm with the approaching one, making almost continuous rainfall. On the morning of March 25th, the trough extended from Texas to New England, with centers over Arkansas and the Ohio Valley. The high pressure in the Canadian region and in the Bermudas kept the area of low pressure over the Ohio Valley from moving on to the eastward. On the 26th the southern portion of the trough moved to the eastward and settled over North Carolina. When the southern portion of the trough passed over the drainage areas of the streams that flow into the Ohio River from the south, the latter were also caused to assume flood stages, thus making doubly sure the resultant destructive flood stages on the Ohio River. On the 27th the high pressure over the Bermudas gave away and the area of high pressure in Canada moved over the Atlantic Ocean, thus permitting the areas of low pressure to move on into the Atlantic ocean, relieving the flood-stricken Ohio Valley.

Thus the two storms passed across the Ohio Valley so close together that the rain areas of the two blended, and the second storm was held back by the two 'highs,' concentrating the rainfall for two successive days in the same place, while the southern portion of the trough moved across the southern tributaries of the Ohio, flooding them at the same time. At no time in the history of the Ohio Valley had so much rain fallen in a 72-hour period as fell last March 23–27. In many local areas, as large an amount of rain has fallen in an equal length of time, but never has there been such a heavy rainfall over so large an area in so short a time.

Again it is of special interest that no low temperatures existed immediately before, during or after this period of flood. At no

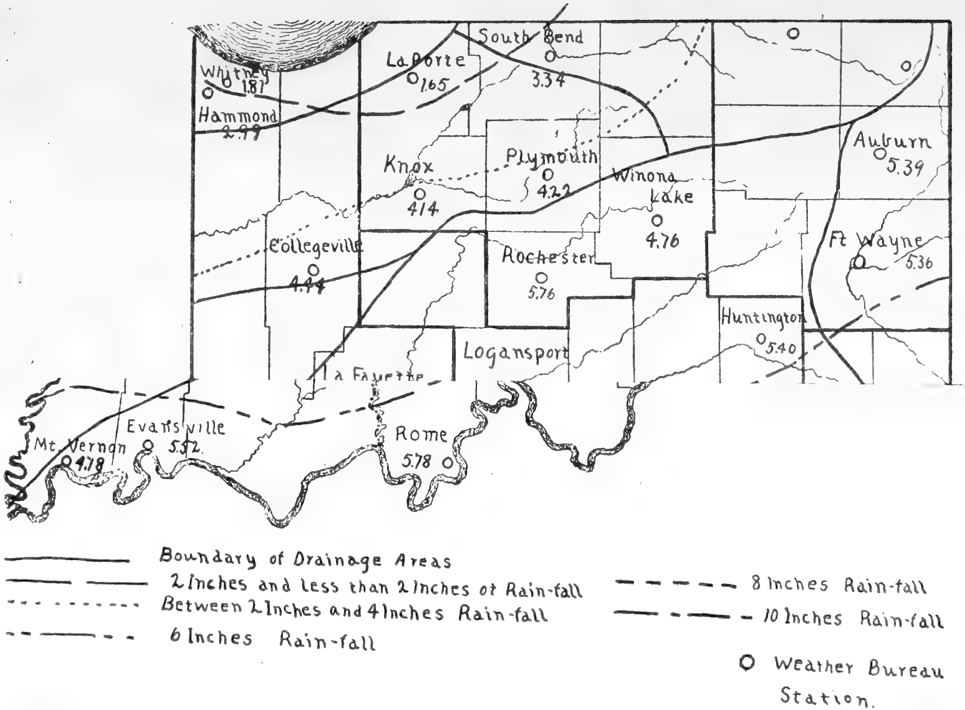


CHART No. 2. Showing drainage basins of the two forks of White River and the rainfall at weather stations.

CHART No. 2. Showing drainage basins of the two forks of White River and the rainfall at weather stations.

place in the Ohio Valley was the ground frozen, nor was there any ice or snow stored away in any part of the basin to aid in causing flood conditions.

In Indiana there had been enough rain previous to the downpour to saturate the ground to such an extent that there was no room left for the absorption of the surplus water; and it is hardly possible that the small amount of water absorbed, even if there had been no rain for some time before the downpour, would have made much difference in the height of the flood. A complete history of the meteorology of these storms, with charts and tables, will be found in the publications of the United States Weather Bureau. The above is based on the information taken from these publications.

TABLE No. 2—*Table Showing Daily Rainfall Upon White River Drainage Basin for the Month of March, 1913.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
West Fork—																															
Anderson	.15	.04	....	.08	....	....	T	T	....	.04	.15	....	.15	.26	....	....	T	....	....	....	.45	....	2.34	1.50	2.51	.50	.14	....	....	....	.19
Bloomington	.31	.02	....	....	.09	.23	....	.03	....	....	.36	....	.01	1.06	T	.05	.03	....	....	.14	1.56	....	.11	.79	6.56	1.12	.62	T	....	....	....
Eminence	.40	....	....	....	.36	.15	....	....	....	....	....	....	.95		T	....	....	....	....	....	.25	....	1.60	1.95	1.45	.25	....	....	....	....	....
Farmland	.25	....	....	.02	.08	.10	....	.01	....	T	.17	....	T	.40	....	.03	T	....	....	.02	.70	....	....	2.97	4.42	.78	.77	....	....	....	.40
Hickory Hill	.26	....	....	.09	....	....	.14	.04	....	....	.05	.23	1.33	....	....	....	....	....	....	.07	.68	....	.42	1.63	4.39	1.04	.05	....	....	....	.50
Indianapolis	.04	....	.01	.05	.09	.02	.05	.01		.25	.01	T	.73	....	.01	.01	....	....	T	....	.46	....	1.27	2.76	1.56	.34	.08	....	....	.01	T
Washington	.20	....	....	.06	....	.12	....	....	....	.09	.23	....	1.17	....	T	....	....	....	....	.36	.85	....	.15	2.08	5.83	.85	....	....	....	....	....
Whitestown	.24	T	.04	.05	.15	....	.02	....	T	.20	....	....	....	.51	T	.01	.02	....	....	T	.62	....	.12	2.98	3.09	.11	.75	....	....	....	.02
Worthington	.27	....	....	T		.17	T	....	....	.30	....	1.00	....	.01	T	T	....	....	T	.07	.72	....	.21	2.26	4.25	.69	.18	....	....	....	....
East Fork—																															
Butlerville	20	....	....	.12	.11	.07	.12	....	....	.09	.11	....	.25	.77	....	.06	....	....	....	.14	.88	....	.14	2.57	4.43	1.56	.57	....	....	....	.17
Columbus	.26	T	....	....	....	T	....	.10	....	....	25	....	.02	.81	....	....	....	....	....	.04	.58	....	.07	1.72	7.00	1.60	.53	....	....	....	.04
French Lick	.24	.03	....	.01	.15	.17	.02	.03	....	T	.42	....	.01	1.01	....	.02	.01	....	....	.24	.92	....	T	.72	4.85	.79	.16	.01	....	....	T
Greenfield	.40	....	....	T	....	.10	T	....	....	T	.23	....	T	.48	T	T	T	....	....	T	.37	....	1.25	2.56	2.32	1.00	.15	....	....	....	T
Mauzy	.30	....	....	.04	....	.13	T	.12	T	.02	.02	....	.20	.42	T	.10	....	....	....	....	.89	....	.56	2.25	5.59	.98	.27	....	....	....	.01
Nashville	.32	....	....	T	T	.15	.01	....	T	.04	.21	T	.33	.69	T	.05	....	....	T	.12	.80	....	.37	2.02	6.01	.52	.05	....	....	....	....
Scottsburg	.10	T	....	....	....	T	T	....	....	....	....	....	.94	....	....	....	....	....	....	.15	1.08	....	.20	2.69	3.41	1.31	.16	....	....	....	....
Seymour	.20	T	....	.09	.04	T	.05	....	....	.05	T	T	.98	....	T	.02	....	....	T	.09	1.24	....	.08	2.05	5.43	.28	.21	....	....	....	.01
Shelbyville	.32	.04	....	.06	.01	.06	.04	.07	T	....	.24	....	.25	.45		.03	.03	....	....	.08	.50	....	.41	2.06	3.57	.90	.17	.03	....	....	.02
Shoals	.45	....	....	.02	....	.29	T	....	....	....	.36	....	....	1.47	....	T	....	....	.30	....	1.19	....	T	6.66	1.80	.45	.15	....	....	....	....
Greensburg	.25	....	....	....	....	....	....	....	....	....	....	....	.65	.10	....	.01	....	....	....	....	.50	....	.45	3.15	4.01	.84	T	....	....	....	T

TABLE No. 2A—Summary of Rainfall Upon White River Drainage Basin for the Month of March, 1913.

	Precipitation for March, 1–22.	Precipitation for March, 23–27.	Total Precipitation for March.	Departure from the Normal.	Greatest Fall in Twenty-four Hours.
West Fork—					
Anderson	1.32	6.99	8.50	4.71	2.25
Bloomington	3.83	9.20	13.03	7.71	6.56
Eminence	2.11	5.25	7.35	....	1.95
Farmland	1.78	8.94	11.12	7.77	4.42
Hickory Hill	2.89	7.53	10.49	....	4.39
Indianapolis	1.47	6.01	7.75	3.75	2.76
Washington	3.08	8.91	11.99	6.97	5.83
Whitestown	1.86	7.05	8.93	....	3.07
Worthington	2.54	7.59	10.13	6.10	4.25
East Fork—					
Butlerville	2.92	9.27	12.36	7.59	4.43
Columbus	2.05	9.92	12.01	8.45	7.00
French Lick	3.28	6.52	9.81	....	4.85
Greenfield	1.58	7.28	8.86	....	2.56
Mauzy	2.42	9.65	12.08	8.45	5.59
Nashville	2.72	8.97	11.69	....	6.01
Scottsburg	2.27	7.77	10.04	5.36	3.41
Seymour	2.76	8.05	10.82	6.46	5.43
Shelbyville	2.18	7.11	9.43	....	3.57
Shoals	4.08	9.06	13.14	....	6.66
Greensburg	1.61	8.45	9.96	5.30	4.01
Average for West Fork	2.54	8.36	10.92	6.93	4.85
Average for East Fork	2.32	8.21	10.14	6.17	4.08
Average for both Forks	2.43	8.28	10.53	6.55	4.46

The average rainfall for the West Fork of White River, taken at nine stations, for the month of March, was 10.14 inches. An average of the amount of rain that fell at the above nine stations for the period commencing with March 23rd and extending through to March 27th, is about 80 per cent of the entire precipitation for the month, or 8.21 inches. At seven of the nine stations therefore, an average of 4.08 inches of rain fell on March 25th, or in other words, 50 per cent of the rain that fell on and between March 23rd and March 27th, fell on March 25th, at seven of the nine stations. That is, 42 per cent of the rainfall for the month fell on March 25th.

On the East Fork of White River there were eleven stations that reported to the United States Weather Bureau. During the five days of the flood there was an average of 8.35 inches of rainfall at these stations. The average for the entire month was 10.92 inches. Thus 76.5 per cent of the precipitation for the month fell during the five days of the flood. Also at nine of the stations an average of 4.85 inches of rain fell on March 25th, or 58 per cent of the rain that fell during the five days of the flood fell in one day, i. e., 44 per cent of the rainfall for the month fell in one day.

Taking both drainage areas together, there was an average of 10.53 inches of rainfall for the month of March. During the

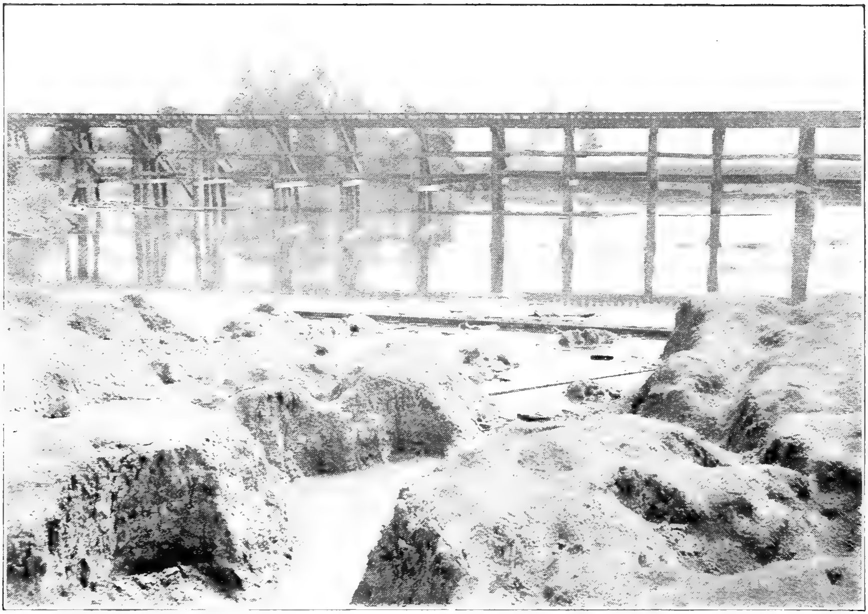


Fig. 5. Washout at Summers ditch crossing, Big Four railroad, Evansville to Mt. Carmel division.

Fig. 6. Washout near Summers ditch, Gibson County.

FIG. 7. Deposits of fine gravel and sand. Gibson County.

FIG. 8. A large deposit of sand and gravel, mostly gravel. Gibson County.

FIG. 9. Deposits near Summers ditch. Picket fence almost covered.

FIG. 10. Sand and gravel deposits in a cornfield. Gibson County.

five days of the flood there was an average of 8.28 inches of precipitation at the twenty stations. That is, 78 per cent of the rain for March fell in five days. Also an average of 4.46 inches of rain fell at sixteen out of the twenty stations on the 25th day of March. There was an equally large rainfall at the other four stations on March 24th. Thus 56.6 per cent of the water, that caused the flood, fell in one day and 42 per cent of the entire precipitation for the month of March fell on one day, March 25th, in White River valley.

The general storm conditions of White River valley were about the same as those of the entire Ohio Valley, which have already been discussed. As was stated above, melting snow, ice jams, and frozen ground did not enter into the consideration of the cause of the flood, as all were absent from the conditions of this State. Neither was abnormal temperature present either immediately before, during, or immediately after the five days of excessive rainfall. However, on March 25th, in the northern part of the State, a light fall of snow occurred, which added misery to all concerned in the flood stricken parts of the different cities. This fall of snow was due to the spreading out of the area of high pressure that was centered over the Great Lakes district.

There is no question but that the flood was caused solely by the enormous rainfall, in the short time of five days, and the fact that 56 per cent of the precipitation fell within the short period of twenty-four hours. If the ground had been frozen, or if there had been floating ice to form jams, or if very cool weather had followed, the deluge, the damage to property and the loss of life would have been vastly greater. On account of the fact that none of these other factors acted in conjunction with the continued downpour of rain, and on account of the fact that the rains came in the latter part of March at a time when there was a minimum of growing crops, or crops in storage, the amount of damage was at a minimum to crops, buildings, and human life. It is difficult to tell whether the soil was washed as badly then as it would have been if the storm had occurred later in the season. The chances are that the soil was damaged more on account of the recent freezing and thawing.

Considering everything, the damage was about as light as it could possibly be, with such an enormous rainfall in so short a time.

Causes of Floods in the Ohio Valley

Floods above the danger line, in the Ohio Valley, have resulted from the following causes, acting alone, or in conjunction:

1. Heavy rainfall over extensive areas.
2. Rapid melting of large accumulations of snows.
3. The formation and the breaking of ice jams.
4. The failure of reservoirs.
5. The breaking of levees.

The first two of these causes acting together are responsible for a very large percentage of the floods that occur during the first four months of the year. A great number of the floods occur during the first four months of the year. For instance, at Paducah, out of the twenty-nine floods that have been above the danger line all have occurred during the first four months of the year. At Evansville, out of the eighty-six floods that were above the danger point, only ten occurred outside of these months; and at Cincinnati, only three out of forty-six occurred outside of the months of January, February, March and April.

The last three of these causes generally act in conjunction with the first two, and in themselves seldom do any great amount of damage over any but a small area. The last flood was caused by excessive precipitation over a large territory, and was not aided in the least by the other flood-causing factors.

FIG. 11. Sand deposits on the east side of White River below Freedom. The hat in the foreground gives an idea of the depth of the sand.

FIG. 12. Sun cracks in sediment deposited at the mouth of McBrides Creek, two miles south of Spencer.

Fig. 13. Shows long rows of sycamore trees along the bank which are beneficial in keeping the bank from being easily washed. Below Romona, Owen County.

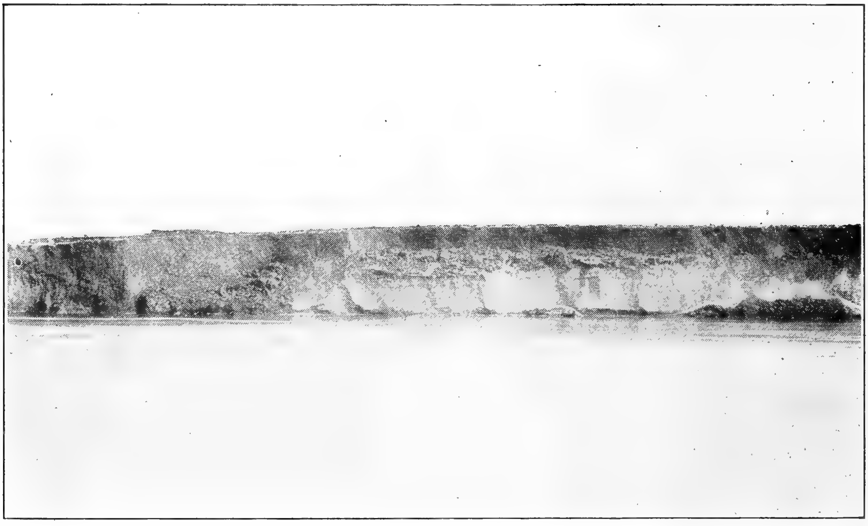


Fig. 14. A typical steep bank at the outside of a meander.

PART II.—OBSERVATIONS

Damage to Soil

Soil Washing and Erosion. When the water begins to flow across the flood plain, sand silt and debris are deposited, their position being determined largely by the velocity of the current. In many places where the current is strongest the top soil is removed and in some places great holes are cut.

The amount of cutting depends upon the velocity of the current, the kind of soil, and the amount and nature of the sediment carried in suspension. I. C. Russell, in 'Rivers of North America,' gives the following table on the transporting power of a stream:

TABLE No. 3.

Velocity of Current.	*Size of Material Moved.*
3 inches per second	Fine clay and silt.
6 inches per second	Fine sand.
12 inches per second	Pebbles ½ inch in diameter.
2 feet per second	Pebbles 1 inch in diameter.
2.82 feet per second	Pebbles 2 inches in diameter.
3.46 feet per second	Pebbles 3 inches in diameter.
4 feet per second	Pebbles 4 inches in diameter.
4.47 feet per second	Pebbles 5 inches in diameter.
4.90 feet per second	Pebbles 6 inches in diameter.
5.29 feet per second	Pebbles 7 inches in diameter.
5.65 feet per second	Pebbles 8 inches in diameter.
6 feet per second	Pebbles 9 inches in diameter.

Russell says concerning the above table: 'It must be understood that the currents referred to in this table are bottom currents, and in general may be taken at about half the central surface current.' A study of the table shows that the transporting power increases in a greater ratio than the increase in velocity.

Le Conte, in his 'Elements of Geology,' shows that the transporting power of a current varies as the sixth power of the velocity. Thus, under this law it will be seen that by doubling the velocity of a current the transporting power will be increased sixty-four times. That is, if a stream having a given velocity will carry a pebble weighing two ounces, it will carry a pebble weighing 64 ounces if its velocity is doubled. This law applies only to material held in suspension. Larger materials may be rolled along on the bottom of the stream bed.

Streams, like White River, which have many meanders have their velocities greatly increased when they assume flood stages, and take a more direct course. The water passes over a shorter distance than when it follows the old winding channel, while the fall between the source and the mouth of the stream remains the same at all times. Thus the velocity of the current is greatly increased, making it more effective as an agent in removing the top soil. A very heavy compact soil will be less affected by strong currents of water than a light loose soil, as muck or sandy soil. However, a very compact heavy soil will be readily cut into holes if the current has sufficient tools with which to work. In many places where the current broke across the neck of a large meander great holes were cut, one to two hundred feet in width, five to ten feet in depth, and in several places three or four hundred feet in length. This was the case at Worthington near where the Eel River enters White River. Mr. East is finishing the new channel and will make a permanent cut-off, thus shortening the river three-quarters of a mile. About a mile above Worthington was another example of the current starting to make a channel for itself across the neck of a large meander. In no case did the current cut a new channel all the way across the neck. If these new channels were extended entirely across the neck in the form of a ditch twelve or fifteen feet in width the increase in fall would soon cause the water to enlarge the channel so that it would carry all of the water of White River, thus making a permanent cut-off.

Holes. Where a stump, hay stack, tree, rock or any other obstacle was in the path of the current, the evenness of the current was disturbed and a spiral downward swirl started on the leeward side of the obstacles which acted in the same manner as water in a whirlpool. It was no uncommon thing to see holes in a field where there seemed to be no cause; but upon inquiry we would be informed that there had been a hay stack, stump, rock or post at that place. Figure 3, shows a hole where there had been a hay stack. Farm implements were seen buried or in holes that had been excavated under them, due to the swirling action of the waters as the current passed around the obstacle. Corners of buildings were let down in the same manner. (See Figure 46.) These holes were sometimes ten or fifteen feet in depth and forty to a hundred feet in length. A break in a levee always caused a large hole to be excavated on the lower side of the break. Generally, the material taken from the hole was carried a short distance below and deposited in the form of a sand and gravel bar.

FIG. 15. The current has removed the top soil to the depth to which it is plowed. In the first bend of White River south of Spencer, in the northeast corner of Section 29. The ridges are caused by the land side of the plow. Sand deposit near the trees along the river bank.

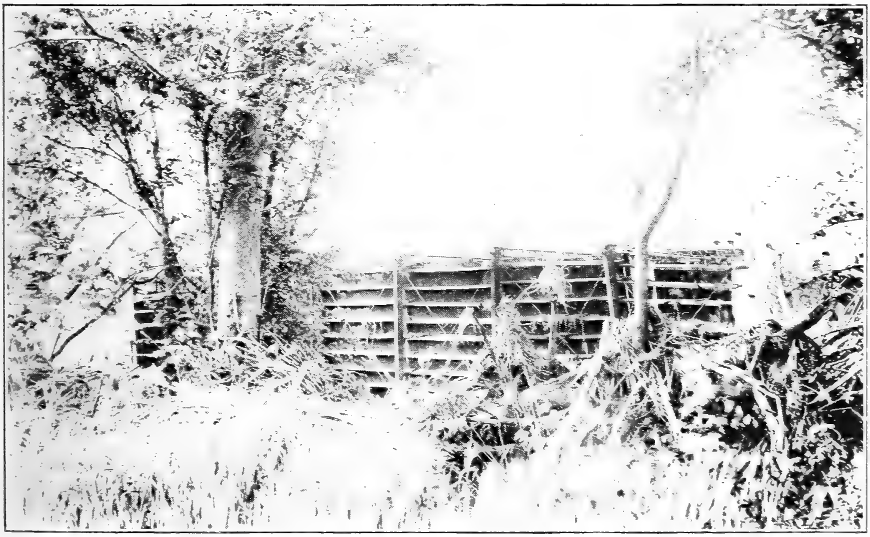


FIG. 16. A thirty-foot bridge that was carried a half mile down stream from the public road north of Brownstown.

Sand and Gravel. When there is a noticeable decrease in the current, sediment is deposited. Gravel and sand in the order of their size and specific gravity, and then the coarsest silt, and last the very fine silt, is the order of deposition. Trees on and near the river bank tend to check the current, causing it to drop the heaviest sediment close to the river, thus building up a natural levee, while the finer silt is carried out to enrich the valley land. There was a tendency for corn stalks to retard the lower current, causing sand to be deposited that otherwise might have been carried on farther. Fences generally had sand deposits on the down stream side. Wire fences caught the floating debris, forming a sort of dam that tended to check the current, and in this way causing a deposit of sand on the lower side, and in some instances on both sides like snow drifts.

It was not uncommon to see as much as twenty-five acres covered with from a few inches to five or six feet of sand and gravel. There were several places where there was as much as sixty and even eighty acres covered with sand. Just below Waverly there was a tract of ninety acres covered. About a mile above Spencer there was about sixty acres, while in the first bend in the river to the south, below Spencer, there was a very large amount of sand. Just below Newberry, there was a tract of about twenty acres, and just below the bridge at Freedom, on the east side of the river, there were about ten acres. (See Figure 11.) Also below 'Blue Hole,' at Washington, there was as much as sixty acres covered with sand, from a few inches to four feet in depth. In most of these cases it will take several years to reclaim this land and get it in good productive condition.

Silt. Where the water was backed up over a considerable area, silt was deposited. The amount of sediment deposited depends on the length of time that the water stood on the ground and the amount of sediment in suspension. The greatest amount of sediment was deposited at the fork of the two branches of White River and at the junction of Muscatatuck with the East Fork of White River. A considerable amount of silt was deposited in the outside of the large meanders, as in the loop at Worthington, where Eel River joins White River. The current from Eel River had a tendency to hold back that part of the White River current that followed the old channel, thus depositing silt and fine sand. Figure 12 shows a small valley just south of Spencer on the east side of the river, in which the back water stood, causing silt to be deposited more than a foot in depth. Mud cracks were developed here in an in-

Fig. 17. Middle ground shows where water had stood on wheat in an old lagoon. In the trees is the bridge that had been carried from the road north of Brownstown.

Fig. 18. Top soil washed away and gravel deposited later. Gibson County.

-teresting fashion. McBrides Creek flows through this valley and furnished part of the sediment.

Bank Cutting in General. Any obstacle or obstruction on or near the bank of a stream causes the current to be deflected to the opposite side of the channel, where it begins to cut away the bank, and is again deflected back to the side where it first started. This is the beginning of a meander.

Bank cutting causes the velocity of the current to be retarded on account of the increased friction. The increased length of the course as well as the increased load also reduces the velocity of a stream. These conditions, resulting from bank cutting, all tend to reduce the velocity of the stream, thus making the flood stages higher. As a rule, a flood plain is made up of materials that are easily eroded or moved. A great many observations along the river showed that the top soil was from one to ten feet in thickness, while the under layers were composed of sand and gravel. This sand and gravel is easily moved by the current which washes it out from beneath the top soil or loam, permitting the latter to cave in. This accounts for the very steep banks on the outside of the meanders, and for the rapidity with which the current removes the material from the outside of the meander. The sand and gravel is carried to the inside of the meander and deposited in the form of sand bars; this is done in a large measure by the cross currents. The soil is lighter and is carried farther down stream and in many cases carried out and deposited on the flood plain. The sand and gravel has been moved from one side to the other many times. Many beautiful cross sections of large sand bars were seen. Figure 15, shows a typical vertical outside bank of a meander. It seems that the shifting of the stream goes on more rapidly when the bank is just full or only partly full of water, for when the water is over the banks that which is left in the old channel seems to have less erosive power, or at least not any more than when the bank is just full. Even if the rate of bank cutting were the same during the over-flow stages of the river as when the banks are just full, the latter conditions occur much more often than the former, and it is therefore evident that there should be some measures taken to prevent rapid formation of meanders.

Effect of Trees on Bank Cutting. Trees along the river bank will to a great extent retard bank cutting. Sycamores and willows are possibly the best for this purpose. Figure 13 shows the roots

FIG. 19. Before the flood reached the crest. Gibson County.

FIG. 20. Hole washed out at Summers ditch crossing. Highway bridge washed out.

of sycamore trees reaching down several feet, helping to hold the bank together. Also small trees and shrubs along the bank will tend to check the current, causing sediment to be deposited, and thus building up a natural levee and at the same time protecting the banks from being eroded. Figure 15 shows this process of building natural levees.

We have seen that the soil from the outside of the meander is carried down stream, while the sand and gravel is carried across the stream to the inside low bank by the cross currents, where it is made into high bars, as seen in Figure 29. In this instance as much as forty acres have been carried from the outside and deposited in the form of a desolate waste, on the other side of the river, in the short time of ten years. It takes many years to reclaim this desolate waste, and after it is reclaimed it belongs to the man who owned land on the other side of the river, the original owner continues to pay taxes on it while the other man farms it. The old saying, 'What is one man's loss is another's gain,' is somewhat applicable here.

The thing that needs to be emphasized at this point is that bank cutting takes place every time that there is a channel full of water, and that the cutting power of the current is as efficient then as when the stream has assumed flood conditions. This phase of the flood situation can be controlled to a great extent, and the most serious cases greatly retarded, if not entirely stopped.

Effect of Trees on Deposits. Two and one-half miles north of Martinsville on the west half of section 19 on the land belonging to Mr. W. E. Hendricks, is a row of trees extending east from the river as seen in Chart No. 2. Mr. K. I. Nutter owns the land east of the row of trees, which formerly extended as far east as the interurban line, but were removed by him. After a glance at the chart the result of the removal is evident. About 90 acres south of the row of trees was covered with silt from one to nine inches in depth, while east of the trees the current was unobstructed and as a result took two to four inches of the top soil from Mr. Nutter's land.

Effect of Grass-Sod on Erosion. Three miles southwest of Spencer on the land of Mr. John M. Dunn, the current left the river and made a short cut across a long meander. Where the current left the river there was a plot of grass some ten acres in extent. The ground covered with grass was not washed or denuded in the least, while the ground below this was robbed of three or four inches

of the top soil. (See Chart No. 3.) Mr. Dunn is of the opinion that it would be better to put the entire bottom land that he owns in timothy, and farm the upland. Considering the price of timothy hay, and the resistance that a good grass sod maintains during flood times, it seems that this would be a very good plan.

Summary of Damage to Soil. The following table gives the amount in acres that was covered with silt, sand, or gravel, and the amount denuded, and the number of acres lost by bank cutting on White River.

TABLE No. 4.

County.	Denuded.	Bank Cutting.	Sand.	Silt.
West Fork.				
Daviess	299	30	77	2,000
Knox	275	28	50	1,000
Greene	1,812	38	256	3,218
Owen	1,699	22	223	289
Morgan	438	27	264	2,370
Total	4,723	145	870	8,850
East Fork.				
Jackson	1,084	9	50	2,400
Washington	143	Very little.	50	300
Lawrence	1,300	Very little.	550	3,280
Martin	1,660	Very little.	50	780
Total	3,127	15	700	6,760
Total for both Forks	7,850	160	1,570	15,600
Estimated loss	At $20 per acre. $157,000	At $75 per acre. $12,000	At $50 per acre. $77,500	

Total Loss in Dollars to Soil $246,500

As far as possible, every farmer was questioned as to the effect of soil wash on succeeding crops. The general consensus of opinion was to the effect that there would be about half a crop the first year, two-thirds the second, three-fourths the third year, and if a subsequent flood did not come there would be a full crop

the fourth year. An ordinary crop on good bottom land is at the very least worth $20 per acre, and on much of it $30 would not be too high. One-half plus one-third plus one-fourth of $20 equals $21.60. This is the basis on which $20 is used as the loss per acre due to soil wash. Thirty dollars may not be too high.

The value of the bottom land varies from $75 per acre to $100 per acre, and there is a greater portion of it worth $100 per acre or more than there is worth less; but it is better to put the price too low than too high. The land lost by bank cutting is a complete loss, hence the loss per acre was placed at $75. The land that is covered with sand and gravel is almost useless for several years, but can be reclaimed after a considerable number of years, so that $50 per acre seems to be a fair estimate of this sort of damage. The farmers say that the ground that is covered with silt does not produce a full crop the first year, but that after the new soil has been frozen the following crop will more than make up for the loss of the first year.

On the West Fork there were some who thought that the sediment which is being brought down in recent years is not so good as that which was formerly deposited over the flood plain. Others could see no difference. The investigators are of the opinion that the silt is not as good as it was before so much of the forest was cut from the steeper slopes. This is especially true of the unglaciated portion of the drainage basin of White River. During the last few years the steeper slopes have been robbed of their forests. The farmers have tried to farm these steep hills and as a result much gullying has taken place. The results of this process is to be seen in the western part of Monroe County and in the eastern part of Greene County. As much as twenty acres can often be found in one area that has been stripped of its grass sod, and numerous gullies have been cut down into the red limestone soil, exposing the limestone below. This soil is easily carried away and when dropped on the fertile alluvial flood plain is not as productive as the finer particles of humus that were gathered from the wooded areas several years ago, and deposited in the same places where the red clay is being deposited by every great flood. To one who has spent three summers studying the geology of the unglaciated part of the State, there is no doubt but that the deposits derived from this part of the White River basin are less productive than formerly and this decrease in productivity is due in a large measure to deforestation. There are several hundred acres in Monroe and Greene Counties that are in the same condition. A fuller report on this

Fig. 21. Public road at Waverly, after the flood. The hole in the foreground was caused by the current enlarging a cellar under a house.

Fig. 22. Large area of sand in the bend of the river west of Spencer. Notice the large sand bar near the trees.

subject will be published later. For a full discussion of the effects of deforestation on erosion, see Mr. L. C. Glenn's, 'Denudation and Erosion in the Southern Appalachian Region, (Professional Paper, No. 72, U.S.G.S.').

Levees and Embankments

One of the most interesting phases in the study of the flood conditions was found in levees and embankments. We will first consider the levees and the embankments as to their relation to the river, their ponding effect upon the flood waters, their effect upon the land, both above and below them, and the effect of the high waters on the levees themselves. Then will follow a consideration of their general effects and conclusions concerning them. They will be taken up in the order in which they came under the notice of the investigators in the progress of the river work. Constant reference to the maps will help the reader to understand the text.

Morgan County. White River in Morgan County flows through the exposed Knobstone sandstones and shales. Since this rock structure is easily weathered and eroded, the valley is remarkably wide, being from one to four miles in width. This great and valuable strip of alluvial land is cut through by the conspicuosly meandering river which does not tend to remain constant in its channel. As a result of this latter condition, man has attempted to hold it in its present channel by means of riprapping and leveeing at different places along the channel. Levees, however, have not been built for that purpose alone, but for protecting the alluvial soil from wash and for the protection of growing crops. We will see with what success these constructions have served their purpose.

The first construction that came to our attention was the public road extending northeast across the valley from Waverly. The water was completely over the embankment which was about ten feet in height in the stretch between Waverly and the cement bridge, a distance of about one-eighth of a mile. On the north side of the bridge it was much less in height. This was a new rock road and was almost entirely destroyed, the rock being carried several hundred feet below and deposited with other debris in a large bar. Next to the town not only was the grade washed out, but a deep hole was made. This was because of a swirl starting from the cellar of a house that was washed away. A very strong current raged at this place, due to the fact that the river turns nearly a right angle

Fig. 23. Looking southwest across White River at Gosport, March 26, 1913; showing ripples as water flowed over Monon track.

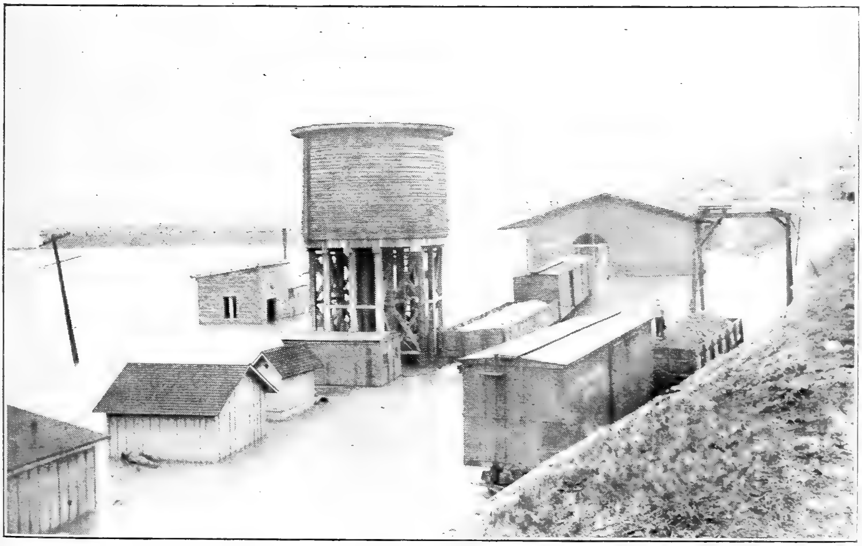


Fig. 24. Monon station, Gosport, March 26, 1913.

just above Waverly, and the overflowing water tended to sweep around the edge of the town in a more majestic course.

The new cement bridge over the river was not damaged, but there is no doubt but that its massiveness and small cross section helped to direct the water to either side. Both approaches to the bridge were washed out. North of the bridge the road was washed away and the rock deposited in the fields below. About a quarter of a mile north of the bridge the largest wash occurred, where a current went across from above. About one acre of land was washed, from two to four feet deep, on each side of the road as a result of the unevenness of the flow caused by going over the road bed.

A small levee planted in trees extended from the bridge to about one-half mile down the river, being parallel with it and about six rods away. This levee did not seem to have any effect outside of keeping the current confined to the river side. The strip of land between the levee and the river was badly denuded.

About two miles southwest of Waverly a small stream enters the river from the west. Parallel with this stream on the section line of 22 and 27 is a large levee extending from nearly one-half mile back to near the river, where it turns at a right angle to follow the river for about one and three-quarter miles. This levee was high enough to be above the waters of the flood, but was broken in three places. The first two breaks were near the turn where the western extension reached the main levee parallel to the river. At each of these breaks occurred a hole from four to twenty feet below the valley land. These holes were made by the concentrated current rushing through the vents made in the levee. Beyond these holes were gravel bars from one to three feet in depth, each covering about an acre of good ground. These two breaks were evidently caused by groundhogs, since several places were literally honeycombed by their burrows.

The third break in this levee was nearly a mile below the first two breaks. This one was very severe indeed. Some twelve to fifteen rods of the levee was entirely swept away and a pond of over a half acre in extent was left in its place. This pond is succeeded by a sand and gravel bar from one to four feet in depth and covering an area of about ninety acres. The bar ends abruptly in a terrace from two to three feet in height, nearly a half mile below the break. A strong current seemed to have hit the levee at this point causing the break, and there might have been a point of weakness here, due to the numerous groundhog burrows. Perhaps as much water flowed through this opening as flowed down the

main channel. This alone would account for the immense sandbar below. By consulting the map it will be seen that this was a natural course for the river to take after the levee was broken through. The current took a short course while the river takes a circuitous course to reach the point where the current entered the channel again.

This levee has perhaps done much good in the past and would have done much good this time had it not been broken through. The water would naturally back up from below and cover this large area of some four hundred acres, and being quiet, much silt would be deposited. A levee situated as this one is would be very useful, if well made; but it must be well made, for if it breaks it will bring great damage to the land that it is supposed to protect.

The next levee that demands attention is in Section 5, about two miles below the one considered above. Again a stream comes in from the west, and a levee fifteen feet in height, constructed within the last few years, extends parallel with the stream for about three-quarters of a mile. This levee lies at a right angle to the river. About the middle of the levee a wing extends to the southward for nearly one-half mile, where it joins the river which has circuited to the west, and at the point where the levee approaches, it turns south again. It seemed that a current of water left the main river above the levee and flowed up the small stream. The levee seemed to be sufficiently high, but it broke in two places. The break again appears to have been caused by groundhog burrows. The first break was between the south extending wing and the river. Quite a deep hole was made here and a corresponding sand and gravel bar was made below, but otherwise very little damage was done, since the area included by the main levee, the wing to the southwest, and the river was mostly covered with silt. The main part of the current went by this break to near the western end of the levee where a break of large dimensions occurred. Below the vent and holes, a large bar from one to two feet in depth covered about two acres. Quite a strong current went through this break, denuding a strip all of the way to the Henderson bridge, where the current again joined the river channel.

This levee with its south-extending wing has been valuable in ordinary overflows in causing the land to be silted, but its use, as in the preceding levee, lies in its being unbroken. It should evidently be protected from the ravages of groundhogs.

The conditions at the Henderson bridge were striking. The current was on the south side of the river channel. It was prob-

Fig. 25. White River at Gosport, March 26, 1913.

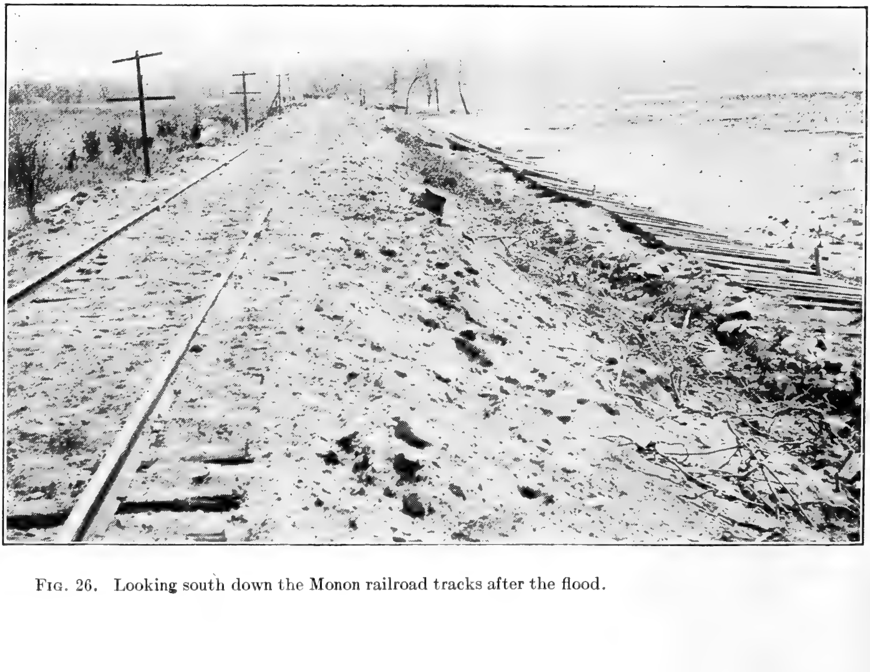


Fig. 26. Looking south down the Monon railroad tracks after the flood.

ably deflected to this side by the current coming from the big break in the levee considered just above. No water passed across the road north of the bridge. A new road had been made and rocked on a twelve foot grade south of the bridge. This grade was literally destroyed, only remnants remaining. The river channel was widened by one-third on the south side of the bridge, thus leaving the bridge ending some sixty feet out in the river. A new span will be needed to complete the bridge. The current that did the damage came from the broken levee above. Where the road grade was so badly torn away, a great pond from four to twenty feet deep and an acre in area, was washed out. Below this hole some twenty acres of land was covered with sand and gravel one to four feet in depth. Land in this condition is worse than useless. The damage here was several thousand dollars and was due to the constriction of the passageway under the bridge.

The next grade that suffered was the interurban line that connects Martinsville to Indianapolis. A mile or more from the mouth of White Lick Creek, the current left the creek and flowed across the valley. This current damaged the pike road and passing on a short distance washed out about a half mile of the interurban track between Centerton and the river. South of the river the current left the channel, making a direct course across the bend, and washed out about an eighth of a mile more of the interurban track. The telephone and electric line wires were torn down. Little or no damage was done to the soil as the grade was rather low.

The Vandalia Railroad bed was also much injured on both sides of the river. About three-quarters of a mile of track was washed out between Centerton and the river, while south of the river about one-eighth mile was washed out. Here again the grade was rather low and not much damage was done to the farm land. There was some denudation, but it was not due to the grades but to the current taking a more direct course across the neck of the meander.

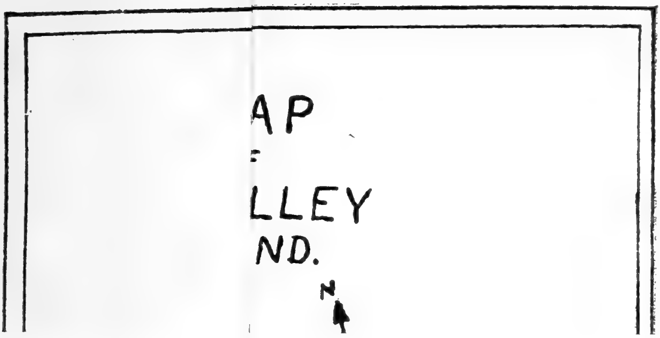
The public road leading northwest out of Martinsville across the valley served as a slight obstruction to the waters and as a result was practically destroyed. The road metal was carried several hundred feet out in the field below and the road bed was washed down to the old corduroy bed. West of the bridge the grade was completely carried away. One pier of the bridge was damaged. Again below the grade there were as usual great holes cut, with the usual sand and gravel bars below.

On the west side of the river about three miles southwest of Martinsville is a high levee about one and one-half miles long,

known as the Bane levee. This levee is built obliquely to the river, coming to the river at its lower end. (See map.) The water did not get sufficiently high to flow over this levee, and it would have been of valuable service had it not been broken in two places. The levee is not planted in trees, but is covered with a heavy blue-grass sod. Some horses and mules were stranded on this levee for several days. The mules attempted to leave and were lost. Near the middle of the levee a break occurred, caused, possibly, by a concentration of the current at this point by a bend in the river just above. This is one of the worst breaks found in the levees along the White River, being second only to the one in the levee first discussed. Where the levee had been, a hole of one acre in area and from five to twelve feet in depth was formed. Below this hole was a huge gravel bar, three feet in depth and five acres in area. The current of water that went through this break went southwest and after flowing two and one-half miles re-entered the river. The current was wide and deposited sediment mainly. It washed only in small patches where there were little elevations on the flood plain. About one-half mile below the break the current encountered a hedge fence against which much drift was piled. This made a veritable levee out of the hedge, but the waters could rush through in many places. This resulted in about ten acres being denuded from six inches to three feet in depth with a great sand bar below.

A second break occurred in the Bane levee near its junction with the river. This break was perhaps less than half the size of the other. It seemed that a great part of the water that flowed through this break flowed up stream (being protected by the levee) and joined the upper current where the land is much lower than it is near the river. The Bane levee was the last of any importance in Morgan County.

Owen County. The flood conditions in Owen County were the most interesting met with along the river. As has been mentioned elsewhere in this report, the geologic structure has been important in the determining of the physiography of the State. Near Gosport the surface rock changes from the soft Knobstone shales to the overlying hard limestones, which are not so susceptible to the weathering agents. Throughout Owen County the valley is bordered by cliffs of limestone and hard sandstone. No longer does one see wide fertile valleys as in the county above. The narrowness of the valley is remarkable. It is from a quarter of a mile to a little less than a mile in width. The water had no opportunity to spread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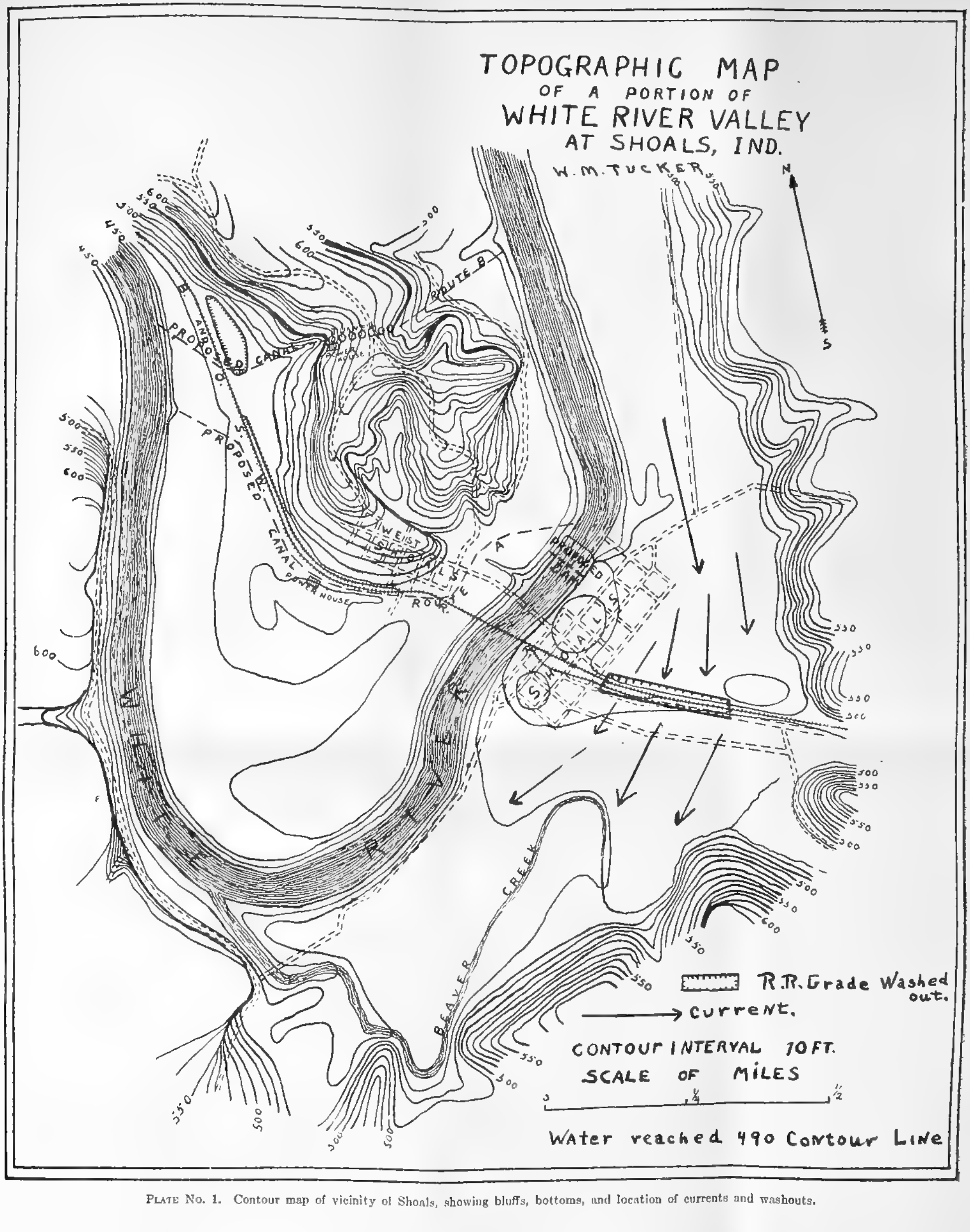


PLATE No. 1. Contour map of vicinity of Shoals, showing bluffs, bottoms, and location of currents and washouts.

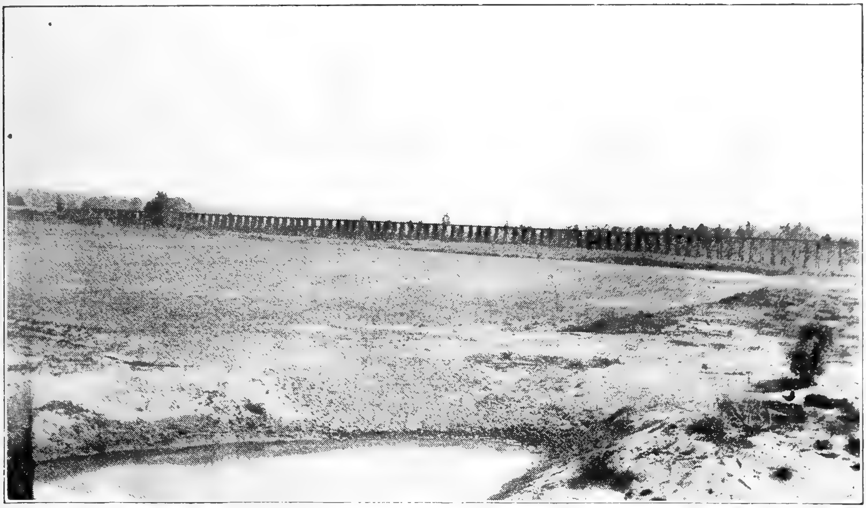


FIG. 27. Trestle of I. C. Railroad at Bloomfield. Neither the trestle nor the bottom land was injured, on account of ample opening for the water to pass through.

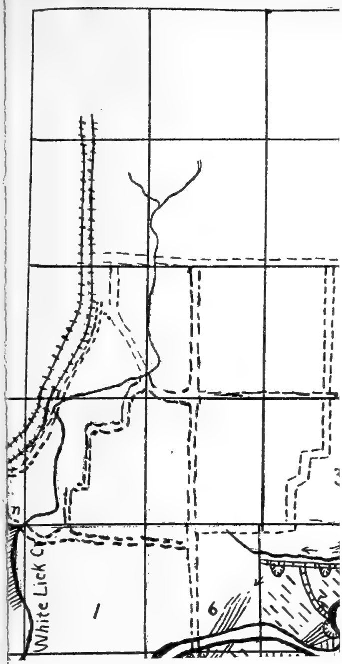
FIG. 28. Bank-cutting west of Newberry, Greene County, on the James Blackmore farm.

over a vast area as in the preceding county, and was consequently much deeper. At places the water was as much as thirty feet in depth on the first bottom. Such was the case at Romona. This great depth increased the head, reduced the friction, and consequently increased the velocity. The result of such an immense amount of water in such a narrow valley can easily be conjectured. The valley was swept clean. A glance at the map will show the conditions.

Since the valley is narrow and meandering, the farm land is not seen in vast stretches, but is in irregular patches of no great extent. There is no such occasion for building levees as there is in the preceding county. Again, perhaps, experience has taught the farmers that levees and embankments do not avail much when it is possible for the water to get thirty feet deep over the valley. At least there are only a few, possibly two, places that demand consideration here.

The first is the Monon grade at Gosport. A glance at the map shows that the railroad grade is in a curve across the valley. The grade is from twelve to twenty-five feet in height, and the only opening is at the bridge over the river, consequently this grade impeded the water and ponded a great amount of it above until it rose sufficiently to flow across. Eye witnesses said that a fall of three to five feet was produced, and that the water broke over in a mighty ripple almost a mile in length. The greatest damage was done to the grade itself. It was more than half swept away, the track being completely turned over with the ties on top of the rails. It was ten days before it could be put in sufficient repair for temporary traffic. The bridge was also injured by the river bed being deepened near one of the piers. Below the embankment the land was heavily silted. At the railroad bridge about an acre was cut from one to four feet in depth. The railroad company suffered the greatest damage here. It seems that there should be at least another section added to each end of the bridge, and to insure traffic against the highest floods there should be some trestle besides. The grade was replaced just at it was before the flood.

The second place of interest in Owen County with regard to embankments is two and one-half miles east of Freedom, on the land belonging to Mr. Frank C. Dunn. Here the river makes a complete semi-circle. It enters Section 23 flowing south, but soon curves to the west, and in Section 22 has curved until it is flowing north. Inside of this loop there are about two hundred acres



White Lick Cr.
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Chart No 3. West fork of White River from Waverly to Gosport, showing effects of flood.

of land of which one hundred and forty acres are tillable. Where the river leaves the bluff at the upper part of the loop, a levee begins and extends parallel with the river for nearly one-quarter of a mile. This levee was almost completely washed out and adjacent to it some four acres of land were cut from one to four feet in depth. Below this badly cut area there were some fifty acres badly denuded, while forty acres were silted towards the western edge of the loop. This levee heretofore had done good service for Mr. Dunn. As long as the water did not get over it, not only was his land in the loop protected, but the water was directed in such a manner as to rob his neighbor across the river and add a corresponding amount to the inside of the bend. Mr. Dunn has declared his intention of rebuilding the levee.

Greene County. In Greene County the river gets wider, and below Worthington it is much wider. This is due to the outcropping of the soft and easily eroded coal measures and to the effects of the Illinois glacial sheet. In pre-glacial times the river ran as much as four or five miles to the west of its present course. It probably ran through the gap that is now occupied by Switz City, thence southward by the present site of Lyons. It seems to have been pushed over to its present position by the great ice invasions of the glacial times. The entire area from Switz City and Lyons eastward to the river is not wholly valley land; it has several great tracts of hill land in it, which are set in the midst of the great alluvial area. The vast stretch of valley land from Switz City and Lyons, southward and eastward to the river was not all under water, but the most of it was near the danger line. Few levees were noticed near the river, but railways and public road embankments offered interesting situations in reference to the flood waters.

In Sections 13 and 14, three and one-half miles east and a mile north of Worthington, a group of levees occurs that demands consideration. They are in a great loop to the south, about which the river runs, coming back northward for a considerable distance. The loop has in it about three hundred acres of farm land. Where the river enters Section 13, a levee was built a year before the flood by Mr. U. G. Clark, who owns the land. The levee which extended along the right side of the river for over a quarter of a mile was washed entirely away. A hole from one to four feet deep was in its former position. The current which left the river here and washed the levee away spread out over and denuded perhaps a

FIG. 29. A huge sand and gravel bar, below the mouth of Veal Creek. The bar is more than six feet above the level of the water.

FIG. 30. Soil erosion on James Blackmore farm, west of Newberry.

hundred acres of land in Sections 13 and 14. The wash was worse adjacent the railroad, which follows the foot of the bluff all along the valley. The current in its lower course before entering the river evidently became sluggish, as much silt was deposited in the western part of Section 14.

Farther down in the loop is a levee extending southward some distance from the river, and on approaching the river, which has turned to the westward, the levee turns at a right angle and extends parallel to the river, but some distance removed from it. The west wing of the levee stands much higher above the land than the north wing. The top of it, however, is no higher than the north wing. Presumably the idea is to have no part lower, and to have all parts above the flood stage. From near the turn in the levee another wing extends to the northeast. This extension is considerably lower and a hedge is growing upon it. This levee system was of no service during the last flood. It was broken in numerous places and heavy denudation occurred at the breaks. Much of the intervening land was denuded.

This group of levees has been of much benefit in the past. They were so arranged that they prevented a current from flowing over the land in the loop, but would permit the back waters to come up on the land, thus depositing a heavy silt and enriching the land. They were not built to cope against a flood that would completely envelope them. The question arises whether it would be a paying proposition to construct levees for such exigencies. This will be considered later.

An interesting situation occurs at Worthington. Eel River flows through a narrow gap between the rocky hill of east Worthington and the steep bluff of 'Old Point Commerce,' northeast of Worthington. This gap is about one-eighth of a mile in width. (There is no doubt that Eel River once flowed to the west of the present site of Worthington.) This small gap is dammed by the Vandalia railroad grade, except at the bridge over Eel River, where an opening of one hundred and eighty-two feet is left. The grade is at least twenty-five feet in height. The country north and west of Worthington is really what may be termed 'second bottom,' belonging to Eel River.

During the flood the water from Eel River had to go through the narrow opening in the Vandalia railway grade. The opening was too small to carry the water and as a result the water was ponded at least three feet higher on the upper side of the bridge than it was on the lower side. The E. & I. R. R. grade running northwest

from Worthington prevented the pent-up waters from escaping over the 'second bottom' west of Worthington, but finally the slight grade gave way and the excess water of Eel River found an outlet to the west of Worthington, down Morgan ditch or Dead ditch, which does not get its ordinary flow of water into White River until near the vicinity of Bloomfield. This release of the water of Eel River caused the water which had been ponded above the Vandalia Railroad grade to fall, but it was this water that flooded the western part of Worthington, thereby doing much damage.

It is evident from the above that the E. & I. R. R. grade for a time protected Worthington from an overflow, and if this grade had been higher and firmer, Worthington would have been safe from the overflow. It is evident also that the Vandalia grade was an obstruction to the free passage of the waters of Eel River, and was a direct agent in the flooding of that city. Without doubt the opening in the Vandalia grade at the bridge should be made longer. This argument is much truer since Mr. Z. I. East has prolonged Eel River nearly one-half mile by directing the channel of White River across a loop, thus shortening its course and causing the old channel of White River to become the Eel River channel for one-half mile.

In the matter of embankments, the situation at Bloomfield is striking. A public road and two railroads cross the valley here at right angles and all within a short distance of each other. The public road with a grade some twelve feet in height comes first on the north side. The Illinois Central Railroad crosses mostly on trestle work a short distance below. The Monon Branch Railroad is just a short distance below the Illinois Central grade. The Monon grade is made almost entirely of stone and is ten or twelve feet in height. There are very few openings in the Monon grade with which to accommodate the flood waters. Some distance above the public road the river swings from a middle position in the valley to the western side, and after passing the three constructions mentioned, it makes a great long loop to the south and finally swings back almost to the Monon Railroad. Then the river turns again, flowing along the Monon grade a short distance until it is deflected southward by the bluff. The meander here makes a letter 'S' with the top of the letter to the west. (See Chart No. 5.)

It might be mentioned again here that the Illinois Central grade has no effect upon impeding the flood waters, since it is composed mostly of trestle work. A short stretch of the trestle

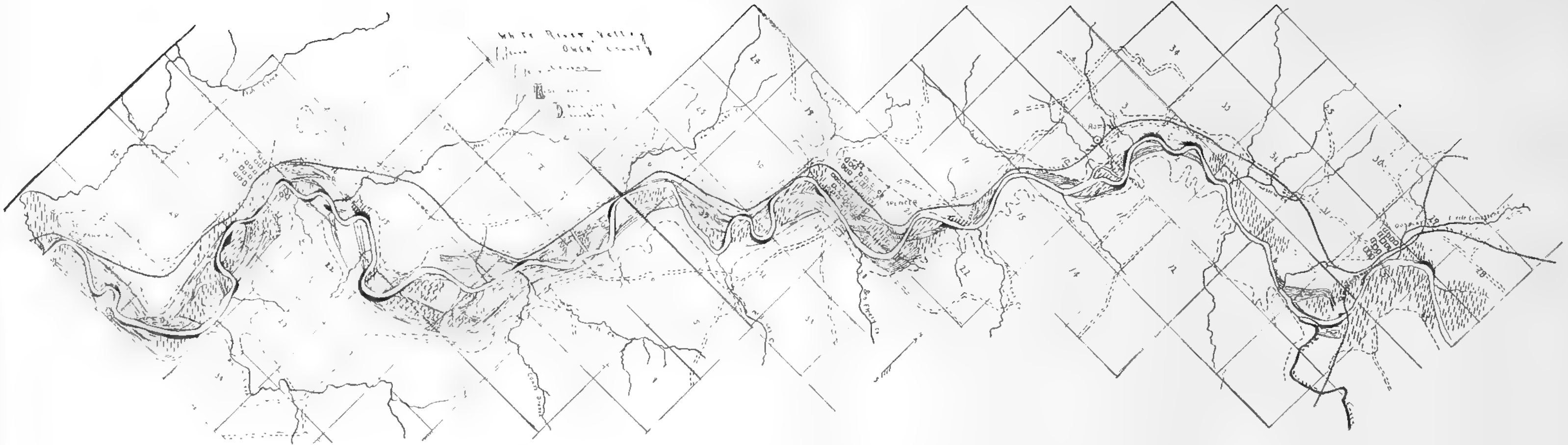


Chart No. 4. Showing the action of the West Fork from Gosport to Farmers.

FIG. 31. Junction of the East and West Forks of White River.

FIG. 32. West of Brownstown. The channel here is more than 40 rods in width. The opposite bank is being cut away very rapidly while the bank on the right of the picture is being extended in the form of a low sand bar.

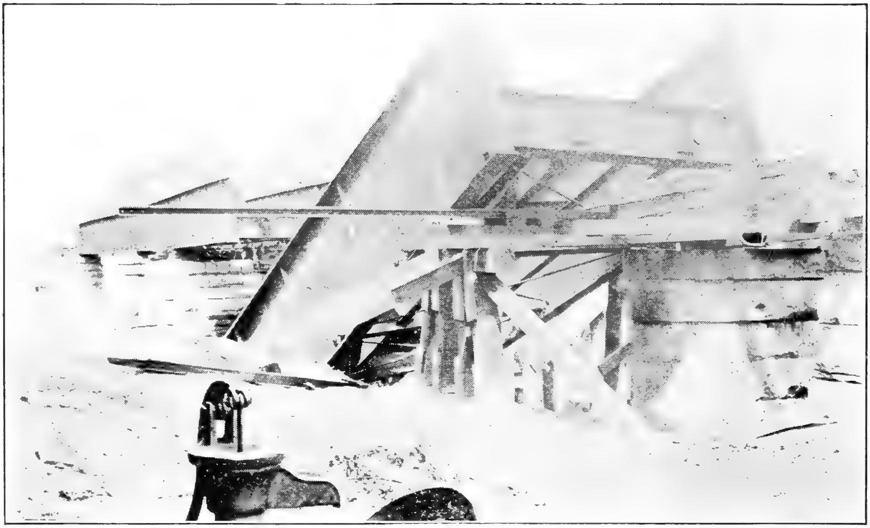


Fig. 33. B. & O. Railroad bridge across White River, above Medora.

Fig. 34. Public road bridge at Rivervale after the flood.

work and part of the grade were carried away near the eastern end where a strong current raged along the bluff. In a very short time they had trains crossing on schedule time.

The public road grade broke in spite of all that was done to save it. It also broke near the western side of the valley, as the grade was lower at that point. About one-third of the material of which the grade was constructed was washed away and the part remaining was cut and washed to the extent that it was impassable for more than two months after the flood. This grade has been rebuilt and paved with cement and this will make it able to withstand the floods of the future. Immediately below this grade the soil was removed, but only for a short distance, as the current was checked by the Monon grade.

The Monon grade, though it was constructed of rock, fared very badly. Just below where the Illinois Central trestle was injured, the grade was entirely swept away. The raging waters tore up much of the grade between this point and the river bridge, and removed all of the track from the grade. It was more than two months after the water had gone down before the road bed was sufficiently repaired for traffic to be resumed. This was quite a contrast to the Illinois Central Railway, which resumed traffic in less than four days.

Below the Monon grade great holes were cut and the land was denuded very severely below these holes. It would have been much worse if it had not been for the peculiar return of the main river current in forming of the above mentioned letter 'S.'

In the southern part of Greene County, just opposite Newberry, is a grade similar to the road grade at Bloomfield. It is some eight to ten feet in height and goes directly across the valley from the bridge next to the bluff on the southern side of the valley. There are, however, two openings in the grade over which are steel bridge spans. About one-third of this grade was removed from the top for over one-half mile. All of the rock was removed and part of the grade that remained was badly cut and washed. The grade was still unrepaired two months after the flood. The land was considerably washed both below and above the grade.

About fifty rods below the road at Newberry is a high levee with a strip of trees and bushes before it and on it. It is built at right angles to the river and parallel to the road grade. It does not extend quite to the river, and lacks several rods of extending to the bluff at the other end. As a result, the water rushed around it at both ends. Many trees and bushes kept the land from being

cut or washed at the river end of the levee, while at the other end where there were no trees, the land was washed very badly for some distance below. To the leeward of this levee about eighty acres was covered with a heavy deposit of silt. In some places the silt was over a foot in depth. This levee was not built with the intention of protecting the valley land, but was built years ago in connection with the old canal between Terre Haute and Evansville.

It is interesting to note the situation where the C. T. H. & S. E. railroad crosses the valley in southern Greene County and northern Daviess County. Long stretches of trestle work are frequent and at the river there is a long stretch. The trestle work permitted the water to pass by, practically unimpeded. Consequently little or no damage was done to the railroad or to the land either above or below the grade. The advisability of trestle work was clearly shown here.

Knox and Daviess Counties. White River, between Knox and Daviess Counties, is a long series of meanders in a wide and dismal stretch of valley land. For as much as three-fourths of the distance no upland is visible from the river. The valley land seems so plentiful that little care is taken of either its improvement or its protection against the meandering river. Each year acre after acre of this fertile land is taken from the outside of the numerous meanders, and corresponding low sandy wastes are made on the inside of the meanders. If this meandering could be stopped, or the river straightened and kept straight, hundreds of acres of fertile land could be utilized, which now are either sandy or swampy waste areas. But the valley land is, perhaps, yet too plentiful for such measures to be considered.

The flood damage between these two counties was not so great as might be supposed, since the valley is so wide the waters spread out in some places as much as five miles. This prevented it from being very deep and from being confined in definite currents, except locally. It was only locally that the soil was denuded by the current passing over it. The greatest damage was in the bank-cutting on the outside of the meanders. As bank-cutting is no worse in times of flood than when the banks are just full, or partially full, the flood did no more damage than any other ordinary high water, so far as soil wash was concerned. The problem of bank-cutting lies in straightening the river and then keeping it straight. It is a question as to whether the benefits derived would meet the cost of keeping it straight.

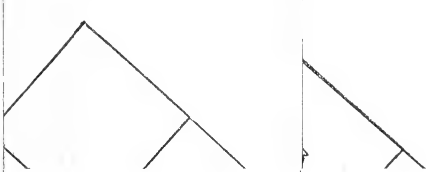


Chart No. 5. West Fork from Farmers to region below Newberry.

cost of keeping it straight.

In regards to levees and embankments very few were present for consideration. The levees near the river were insignificant and seemingly had no effect for bad or for good. Only one embankment occurs that deserves consideration. Outside of the damage done by bank cutting, nearly as much damage was done below the B. & O. Railroad grade near Washington as was done within the entire river scope of the two counties. The grade is high, being perhaps twenty feet on the average. There is no trestle-work west of the river and very little east of it, thus compelling the enormous amount of water to rush under the bridge. The central pier was washed out and the steel bridge collapsed. Nearly a mile east

Fig. 35a. Frogeye, in Shoals, looking south.

of the river there was a short trestle-work across a hole known as the 'Blue Hole.' This trestle-work was carried out and part of a train was carried down with it. Four lives were lost here. The bodies of two of the victims were not found until two weeks later, when they were found under several feet of sand. Below this 'Blue Hole' sixty acres were covered with sand from a few inches to five or six feet in depth. On the west side of the river just below the bridge two acres were cut from the bank where the water rushed against it in coming through the opening under the bridge. Large trees were washed out and carried away. Six hundred acres were denuded, and forty acres of wheat were washed away, and eighty acres were covered more or less unevenly with white sand.

Most of the damage done here was due to the railroad grade. Had there been sufficient trestle work the damage would have been slight. Despite all of this, no trestle work is being constructed.

East Fork of White River. That part of the East Fork of White River which was investigated as to the flood conditions has only a few features in common with the West Fork. In the first place, the waters were much higher, mainly because of the superior abundance of rainfall within its basin; secondly, because of the narrowness of the valley itself, which is very similar to the West Fork in Owen County; and thirdly, because of slighter fall.

Fig. 35b. Frogeye, in Shoals, looking south.

The region above the junction of the Muscatatuck River with White River, is similar to the Morgan County region of the West Fork. Here the valley is wide for the same reason that the valley of the West Fork is wide, i. e., it is in the Knobstone region, with its soft and easily eroded sandstones and shales. Below Sparksville the valley ranges from less than a quarter of a mile in width to about a mile. It seldom gets over three-quarters of a mile in width, and generally is about one-half mile wide. Through this latter region the valley is really a great meandering groove with the river passing from one side to the other as the entrenched meanders of the valley turn in one loop after another. The channel itself has for ages, so to speak, remained in its present site. It does not cut

its bank on the outside of the great meanders, because the outside of these meanders is the outside of the valley itself, and is usually a steep rocky wall, one to three hundred feet above the stream.

There were no levees noticed in the stretch of river between Brownstown and Shoals, but there were a few railway embankments that need consideration. The first of these is the Baltimore and Ohio Southwestern embankment near Medora in Jackson County. The valley here is nearly three miles in width. It is in the Knobstone region. This B. & O. grade across the valley will average some fifteen feet in height. There are no trestles east of the river and only three or four short stretches to the west of the river. The grade comes to the bank of the river on both sides. As a result of this inadequate trestle-work, as much as a mile of the grade was washed out, or partially so. The short stretches of trestle-work on the west side of the river were washed out on account of the concentration of the current at these points. The second pier from the east end of the bridge was undermined and the structure collapsed. (See Figure 33.) The land was badly washed below this grade, and sand and gravel were deposited in several places. On the west side of the river ten acres were covered with sand from a few inches to three feet.

Before the grade broke, the water was much higher on the north side than it was on the lower side. This caused the village of Medora to suffer considerably. This condition was due to the inadequacy of the trestle-work. If the water could have passed freely, much damage would have been avoided, and several thousand dollars would have been saved the B. & O. Railroad.

The B. & O. bridge over White River south of Bedford was not damaged, but about two hundred feet of the high grade on the south side of the river was removed. (Fig. 3 shows the crew replacing the grade instead of putting in trestle-work.) It seems that these grades should be replaced with trestle-work, but it may be less expensive to have traffic tied up for short intervals, and to build new bridges than to go to the expense of putting in trestle-work.

The Monon Railroad crosses the valley at right angles, three miles south of Bedford. There is no trestle-work here. The grade approaches to the very river banks. As a result considerable stretches of the track were washed out. Again the grade was rebuilt and no trestle-work installed.

The situation at Shoals is very peculiar. The special plate shows the relations. As can be seen, the part of the town east of the river is built on a hill situated in the middle of an alluvial

Fig. 1. Showing hole cut by current where it passed over a levee. One mile south of Romona.

Fig. 2. A typical hole washed out by the current. One mile south of Romona.

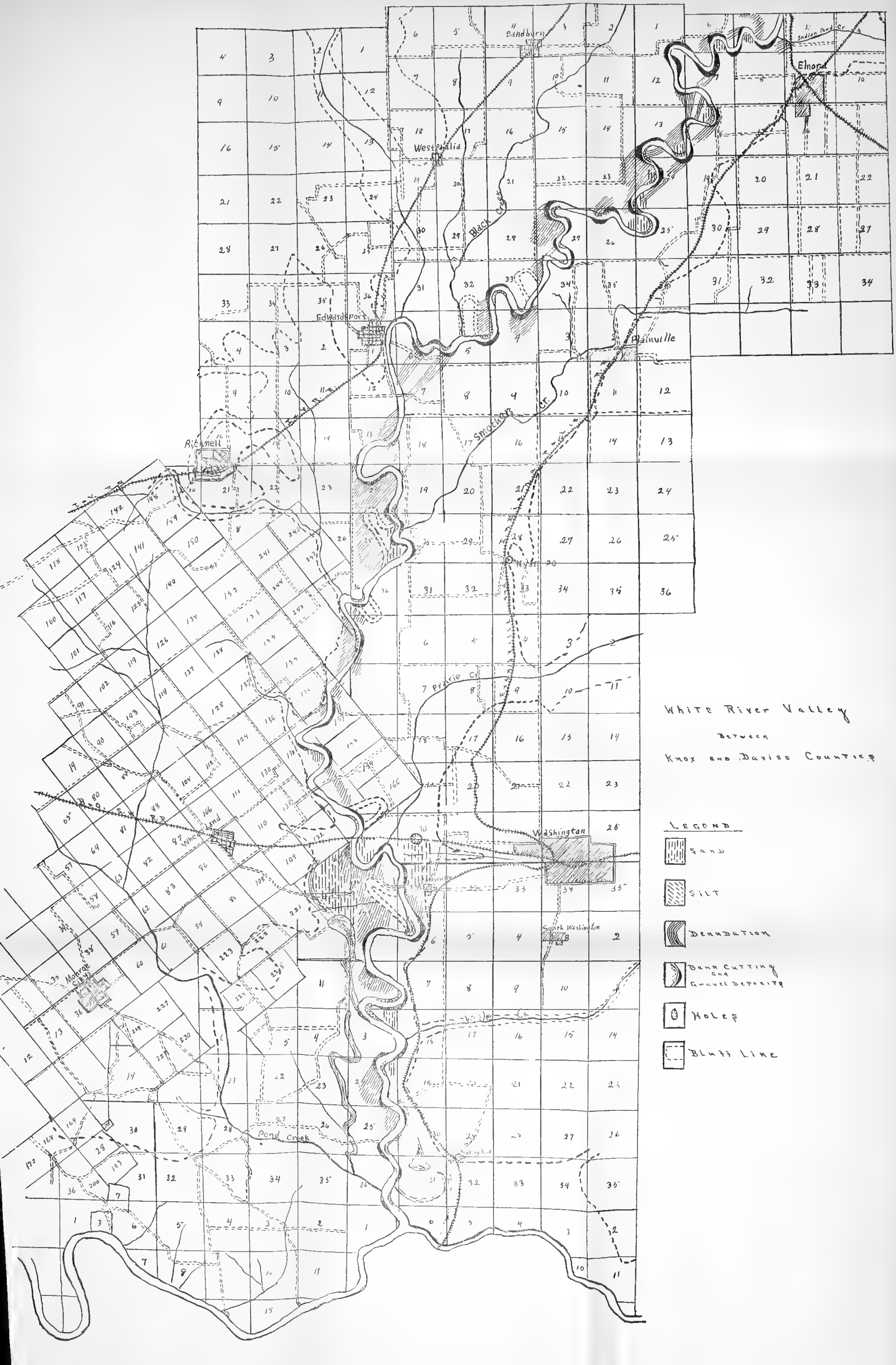

White River Valley
Between
Knox and Daviss Counties
Legend
Sand
Silt
Denudation
Bank Cutting and Gravel Deposits
Holes
Bluff Line
Sandborn
Elnora
Westphalia
Black Creek
Edwardsport
Plainville
Smothers Cr.
Bicknell
Prairie Cr.
Wheatland
Washington
South Washington
Monroe City
Pond Creek

FIG. 2. A typical hole washed out by the current. One mile south of Romona.

valley. The plate indicates the part of the B. & O. track and grade that was removed. (See also Figs. 35 to 40.) There is no doubt that the railroad grade at this place should be partly replaced with trestle-work. On the west side of the river not only the railroad grade but the street that connects West Shoals with East Shoals served as an obstruction for the water. The cement sidewalk was torn away, but neither of the grades was badly injured. The great bulk of the water went around to the east of the town and came into the river again near where Beaver Creek enters the channel. In all, forty-four houses were either removed from their foundations or carried away. This would have resulted regardless of the railroad grade, the houses themselves being situated on the flood plain within reach of high waters.

Conclusion. The consideration of the levees along both forks of White River brings out the fact that during the March flood all of the levees brought disaster. Not only were they damaged themselves but they caused the adjacent territory to be washed and denuded, in many cases very badly. Now, since this was true in the recent flood, it will be true of future floods that approximate the recent one. We are now ready for the pertinent question: Is it worth while to provide protection against such floods in the future? We will presume that the above question is answered in the affirmative, just for the sake of showing how simply and practically protection may be provided in regard to railroads and public road embankments. From a study of the conditions as they are briefly given above, the following conclusions present themselves:

1. Railroad embankments have almost invariably impeded the free passage of the water and caused it to be ponded above for a time.
2. Railroad embankments suffered severely and in some cases bridges were destroyed.
3. By the breaking of the embankment, the land below has been greatly damaged and in some cases injured beyond reclamation.
4. A noticeable lack of trestle-work was the cause of the water being impeded and ponded.
5. Near Riverside, Greene County, the C. T. H. & S. E. R. R. had plenty of trestle-work and no serious damage was done, either to the embankment or to the land immediately below.
6. The I. C. R. R. at Bloomfield was only slightly damaged because of the long stretch of trestle-work that permitted the water to pass unimpeded.

FIG. 36. Mill Street, West Shoals, looking south.

FIG. 37. B. & O. grade, east of Shoals, after the flood.

FIG. 38. B. & O. grade between East and West Shoals. Note crooked track.

FIG. 39. Water flowing over railroad grade between bridge and West Shoals.

7. Public road grades, such as at Henderson Bridge in Morgan County, at Bloomfield, and at Newberry suffered considerable damage because of the inadequate passage-way for the water at the bridges.

8. Some public roads suffered because the flood waters were high above them rather than because they impeded the waters.

9. Where trestle-work was sufficient near the river, neither the bridges nor the grades nor the land below suffered any considerable damage.

From these conclusions, it seems that the way to prevent damage by future floods, so far as railroads and public road embankments are concerned, would be to provide more trestle-work. This remedy is both simple and practical.

The levee question along White River above the junction of the two forks is but little related to such a question in a great valley like the Mississippi River Valley. In the Mississippi valley the object in view is to keep the great volume of water that comes from the upper tributaries confined to a relatively narrow channel, and to keep it from spreading over the entire valley, or at least any considerable portion of it. Along White River the object in view is to protect small areas from currents which would wash and carry away the top soil. In many cases it is not desirable that the water should be kept off the land, as back water generally enriches the land with its deposit of silt. However, the levee question along White River is related to the lower Mississippi River problem in the fact that White River is a tributary to the Mississippi River, and the rate of discharge, etc., all have an appreciable effect upon the lower course. For instance, should all of the tributaries be improved before the lower course of the river was improved, serious consequences would follow. Local improvement only tends to make the damage more intense farther down the course. The levee situation on White River has little in common with the levee situation of the lower Mississippi River, but there must be some co-operation in the plans of the improvement of the two different parts of the same river system. Improvement should begin at the lower course and be extended toward the tributaries.

The levees which were encountered during the flood investigation were all built with the idea of protecting a small area of land, and they were all wisely planned for that purpose. These levees served well in ordinary overflows. In the March flood they were all failures. They were not strong enough to withstand the pres-

CHART No. 7 Map of East Fork from Brownstown to Sparksville.

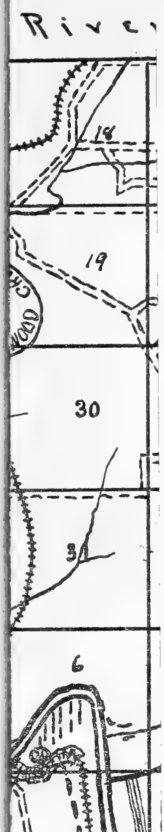
sure of the water, or were not high enough. Would it be practical to construct levees both strong and high enough to protect the land from floods of the proportions of the recent one?

The writers believe that it would be practical to construct levees of such a nature. Several of the levees considered were high enough, but were weak in places. In most cases it would be well to have them higher. A levee is like a chain; it is no stronger than its weakest link. The weak places should be strengthened. The most dangerous enemies to the levees seemed to be the groundhogs. In very few cases do the levees need to be protected with a rock covering, but it would be well to have trees and shrubs growing on them. The levees considered in this paper were effective for years before the 1913 flood, and would have been effective then if they had been a little higher and a little stronger in a few places where they were subject to unusual strain. The extra expense in making them flood proof would be nominal, and if they are to be used at all they should be made strong, for a weak levee causes much damage when it breaks.

There are many places along White River which could be protected by levees. Even in many of the narrower confines of the valley, levees could be made with much benefit to the land. For instance, along the East Fork of White River the valley itself is continually turning to the right and to the left and the river crosses from side to side in its tendency to be always on the outside of the turn. Where it leaves a bluff on one side to cross to a bluff on the other side, the river bank is usually low; sometimes there is no bank at all, and a low strip of land continues to 'B,' on to 'C,' but usually it is much lower at 'A' and 'B' than it is at 'C,' where the current enters the river channel. The current flows in this low strip whenever there is even a minor flood. A levee placed at 'A' would be hard to hold, but one placed at 'B' would not be so likely to be washed away since the current from the river channel would not strike it. A levee placed at 'B' would need to be very little higher than the valley land near the river where it is usually highest. Such a levee would in time cause the low strip to fill with silt and would be a great improvement to the land. The low area to the leeward of the levee would probably become a pond or be very wet, but this condition could be overcome by tiling.

Fig. 40. Railroad bridge at Shoals.

Fig. 41. Water ponded in little stream about Southern Indiana Power Company's dam at Williams.


Rive
18
19
30
31
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Valley of East Fork of White River in Lawrence County.

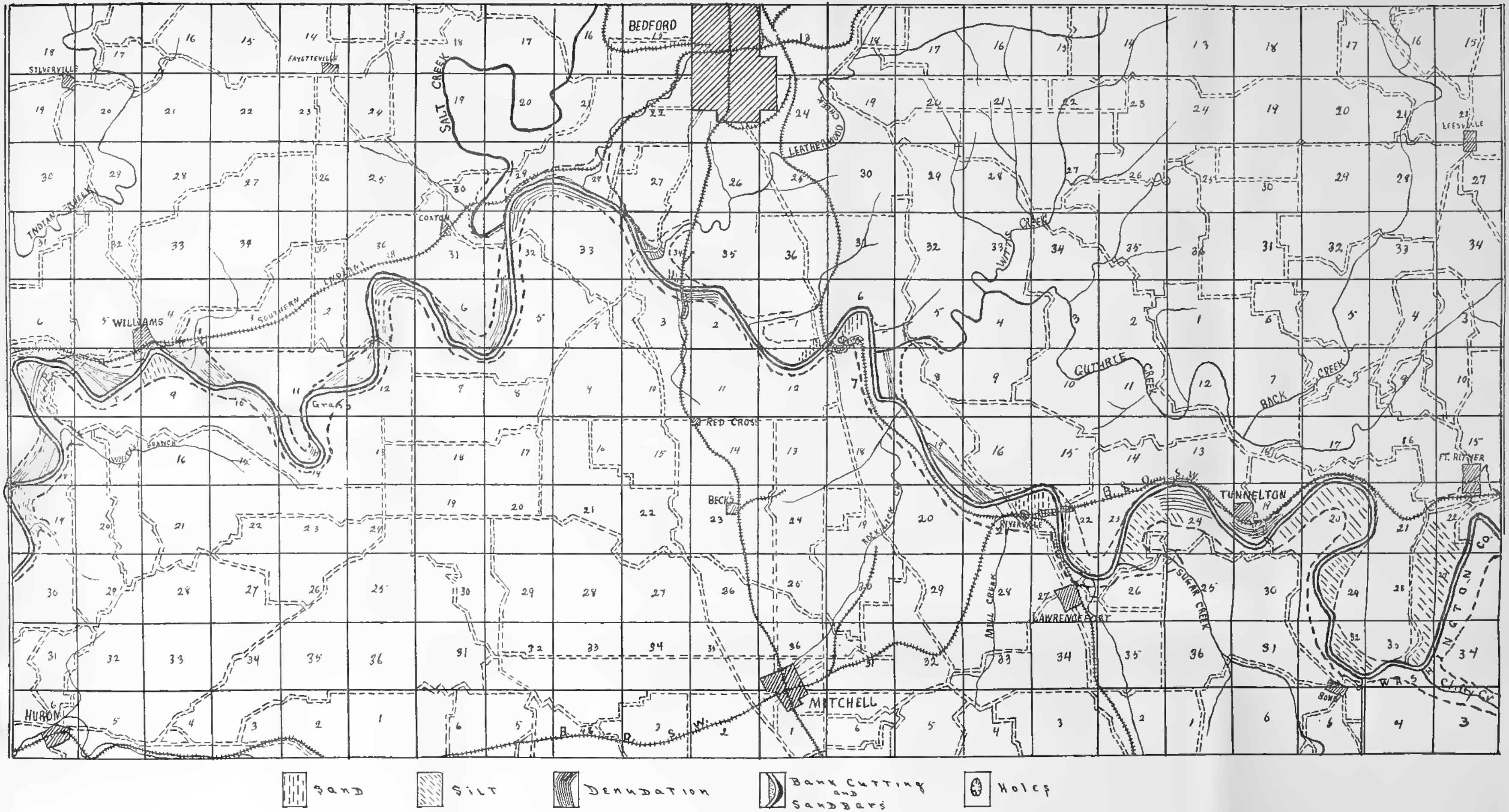

Chart No. 7. Map of East Fork from Ft. Ritner to a place five miles southwest of Williams.

Bank-Cutting

Several times in this report, bank cutting has been particularly mentioned as an important phase of the flood situation. Mention has also been made of the fact that bank-cutting is not confined to flood stages, but to stages when the water is three or more feet above low water mark. As a rule, the bottom of the river channel and the lower part of the banks is somewhat tougher than any part above. No bank cutting goes on in the low water condition; but as soon as the water has risen three or four feet in the channel, it begins to come against the outside bank of the river in rounding a meander, and comes in contact with the looser material above the tough, compact, lower part. Caving is then an immediate result. As the water rises higher, it gains in velocity and its efficiency for bank cutting increases until the channel is bank full. This is probably the most favorable condition for bank-cutting, for, as soon as the water begins to flow over the valley land, across the neck of the meander, some of the force of the current is taken in the direction of the overflow, and the velocity of the current is checked, thereby lessening the cutting power. Moreover, when the water rises high over the valley land, the thread of swiftest flow is raised, perhaps, above the banks and bank-cutting is lessened.

It is interesting to note the relation of the height of the river banks to the width of the valley. On the West Fork above Gosport and on the East Fork above Sparksville, the valleys are from one to four miles wide, due to the very susceptible erosiveness of the Knobstone Group of Rocks. In these regions the banks are low, ranging from six to twelve feet above low water mark. From Gosport to Worthington, on the West Fork, and from Sparksville to the southwestern corner of Martin County, on the East Fork, the valleys range from less than a quarter of a mile to a mile in width, due to the highly resistant erosiveness of the Upper Mississippian rocks and the Mansfield sandstone of the Lower Pennsylvanian rocks. The banks in these regions are from twelve to forty feet above low water mark. The remaining parts of both forks are in the easily eroded coal measures, and the valleys are, therefore, wide. Again, the banks are low, ranging from eight to fifteen feet in height. Thus, in the wide valley regions, the river banks are low, and in the restricted valley regions the river banks are high.

The above conditions and relations are easily explained. In

the wide valley region, the streams meander about in the wide alluvial expanse, continually cutting on the outside of the meanders and shifting the channel of the stream constantly. This constant shifting or changing of the river channel gives no time for the incision of the stream bed, or for the building up of natural levees along the banks. This shallowness of the channel keeps the stream in the easily moved sand and gravel underlying the sandy soil of the surface, and does not permit it to have the tougher, compact material for its banks. Such conditions favor bank-cutting and meandering. Should the stream have time to cut down into the more resistant material, it is likely that the bank-cutting would be less. The alluvial material of the valley however is deep, since the valley is a filled valley; probably seventy-five feet in depth below the present river channel.

In the narrow valley regions, the channel does less meandering and especially in the East Fork region, where there is little or none. Consequently, it has remained in its present channel for a very long time, and has cut down into the more resistant material. Trees have grown along the banks and natural levees have been made. The channel, therefore, is deep. Perhaps the most important factor in keeping the channel constant is the narrow winding valley itself. The valley in these restricted regions is a great intrenched meandering gorge. The channel crosses from one side of the valley to the other, always keeping its outside bend against a precipitous limestone or sandstone cliff, with the valley always on the inside of the bend. This condition exists because of the winding valley itself. It is impossible for further meandering to take place, because the outside of the bends is always against a rocky cliff generally over a hundred feet in height. This is sufficient to explain the much greater depth in the constricted regions of the White River valleys.

Before considering the details of bank cutting along White River, something should be said about the need of the preservation of the land affected and the loss to society in general because of the consequent loss in production. If the present rate of increase in population continues, there will be 200,000,000 people in the United States by the year 1950. When we stop to consider what it means to produce twice as much as we are producing now, we are constrained to think of vast numbers of acres called into use which are not at present available. As the population increases, more and more food is needed; but the subsistence space does not increase. It is even made less, for actual room is used

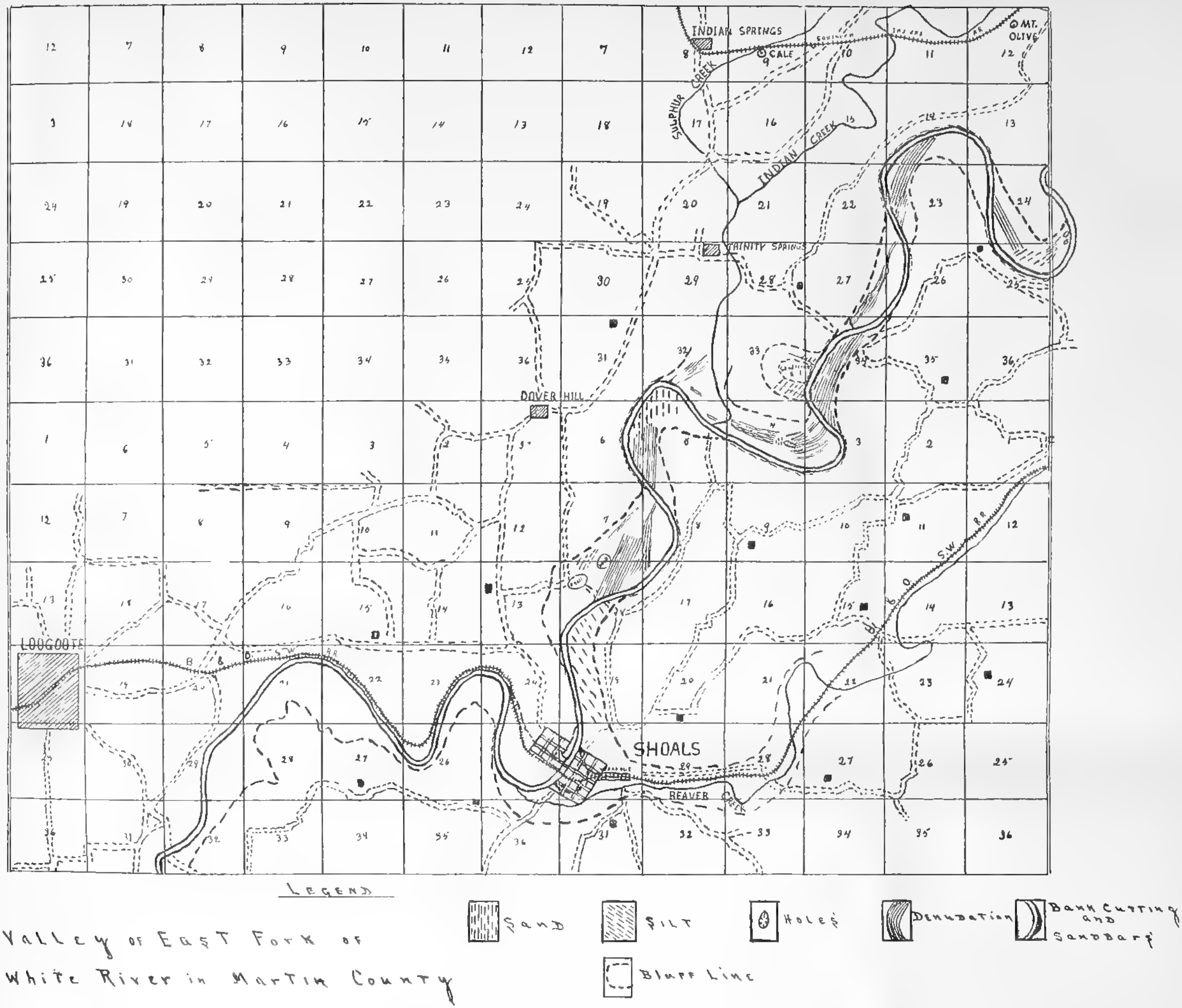

CHART No. 8. Extending from Chart 7 down East Fork to Loogootee.

which might otherwise be areas of production. Since the subsistence space never becomes greater, the land that is not now practical for production is the land that is the most desirable. Valley lands with their deep alluvial material are, as a rule, fertile. They form the cream of the land. For ages the rich soils formed on the uplands by decaying vegetation and animal life have gradually accumulated in the valley lands. The vast fertile stretches of the Mississippi valley, one of the greatest and most fertile areas in the world, are perhaps the greatest asset that the American people have. Yet there are thousands of acres lying in idleness, waiting for the time to come when the population has so increased that these areas will be demanded for subsistence space. The time is coming near; already the clamor is heard in the numerous schemes and plans for making this land available for production.

Let us see what it means for an acre of land to be lost by bank-cutting and caving. It is true that land thus cut out by the waters is not absolutely lost, but it is unavailable for at least ten years, and probably twenty years. All figuring, however, is done on the least number of years; but it is to be understood that double the loss due to the lack of production may be figured, and the result be as nearly correct. The coarse material cut from the outside of the meander is carried across the stream by cross currents and deposited on the lower and inner side of the meander. The finer material is carried on in suspension, and usually the most of it is deposited as silt over the valley land where the waters are relatively quiet. The sand and gravel bar thus made on the lower inner side of the meander grows larger each year, and gradually vegetation grows upon it. This vegetation, though scanty at first, is an important factor in causing silt to lodge, and gradually the bar is built up with a layer of fertile silt or soil on top. But it takes at least ten years, or probably twenty, for this to take place. Our acre of land has been lost for ten years at least. During this time it could have been producing sixty bushels of corn yearly. At fifty cents a bushel this could have brought thirty dollars. In ten years three hundred dollars have been lost to society, plus the seventy-five dollars that the acre of land itself would bring at present. In figuring this, one of the cheapest crops has been used; but it is a crop that is now practical for such acres as are now being lost annually along White River. If the figures were for one of the more intensive crops, they would show a loss running into the thousands. The time is coming when the loss will be so calculated.

Bank-cutting is not much of a problem in the constricted val-

ley regions, and especially so in the constricted region of the East Fork, since the channel does little or no meandering except to follow the intrenched meanders themselves. Considerable bank-cutting occurred, however, in the constricted region of the West Fork. This will be explained later. When in flood stage, the water tends to go directly across the valley next to the sloping bluff, rather than follow the channel across to the other side and sweep around the cliff on the outside of the intrenched meander. (See Diagram 2.) The position where the water leaves the channel ('A' in Diagram 2) is usually low, and sometimes considerable bank-cutting is done. A typical instance of this kind occured in Owen County above Spencer, a short distance below the mouth of McCormick's Creek. Despite the fact that trees were growing here, and that ballast had been hauled and dumped at the place, much cutting was done. But such places in themselves are rather insignificant in comparision to the wash below them, and the bank-cutting in the meanders as found in the wider portions of the valley.

It is understood that in the wide valley regions of both forks of White River, the outside of nearly every meander is growing larger each year, and fertile soil is being undermined and carried away. To call attention to every meander in these regions is not the purpose of this report. A few typical illustrations will be chosen and sufficient detail given to enable the reader to understand the situation. Constant attention must be given to the charts.

In Morgan County from near Martinsville, to the vicinity of Little Indian Creek below, there is a stretch of about five miles of river which is relatively straight. (See Chart No. 2.) Damage done to this region was relatively slight except that due to bank-cutting. Attention is called to this section of the river because as yet the meandering is incipient. The ones started will become larger and larger as time goes on, and in a few years they will be relatively large. The damage done then will be many times what was done in the recent flood. The first bank-cutting in this stretch of the river occurred in the slight bend just north of the Vandalia Railroad bridge. A strip of land from forty to sixty feet wide and twenty rods long was taken away. This only accentuates the bend here. If nothing is done to prevent the cutting here, the cutting will continue year after year, making the bend larger and farther down stream, until the grade and abutment of the railroad bridge will be threatened, having come within the scope of the enlarging meander.

Between the railroad bridge and a small creek coming in from

the west, the current cut across as indicated in Plate No. 2, and made waste land of about five acres. Some of this was badly cut, while the remainder was covered over with coarse gravel. The current of the bank-full stream was deflected to the other side of the river where it cut considerably into Mr. Rutledge's land. He lost perhaps a half acre of good soil. There is no doubt that this meander will continue to grow until it has united with the one below the place where the stream enters the river. Such a meander in the course of a few years will destroy several acres of land on the east side of the river.

In the southwest corner of Section 12, about one-fourth acre was lost by bank-cutting. About as much was lost in Section 14 on the same side of the river. These two places are typical incipient meanders; as yet they are small, but, as is the case with all meanders, they will grow larger each year. It was said that the lower one was started by a charge of dynamite being exploded near the right bank in an endeavor to kill fish. Anything that deflects the current against the bank will start a meander. Cases were noted in which logs and other debris were so lodged as to deflect the current sufficiently to start a meander.

Southwest of Paragon is a stretch of river in which great damage was done by bank-cutting. Chart No. 2 shows the extreme crookedness of the river at this place. This extreme meandering will never correct itself. Although cut-offs may be made frequently, they are never made in nature with any degree of permanency, because of the little crooks left which immediately develop into new meanders. This place shows that a cut-off was made recently which partially corrected the most extreme meander, but another is already begun which in a few years will be as bad. As a result of this constant meandering, a great tract of the land here, which ought to be worth one hundred and twenty-five dollars an acre, is either a sandy or a swampy waste.

The particular damage due to bank cutting alone is as follows: In Section 22 opposite the large island, one acre was lost. In rounding the next meander on the left side of the river, three acres were cut from the bank. Opposite this cut is a bare gravel bar of about six acres. Directly north of this on the right bank in Section 16, three more acres were carried away. Opposite this cut is a gravel bar of about four acres. Three acres were also lost in the succeeding meander on the right bank just before reaching Burkhart Creek. Opposite is a gravel bar of about five acres. The next loss is below Burkhart Creek; it also consists of about

three acres. The bar opposite this cut is at least ten acres in extent, all of which is entirely bare of vegetation, showing that it has been made within the past two years. Immediately below this great bar the current of the channel has made another cut of about three acres. This is the last meander in this remarkable series. Thus during the last flood sixteen acres were lost within an air line distance of two miles. This means a loss of something like two thousand dollars for the land alone, to say nothing of the accumulating crop loss for the minimum ten years.

The region is very susceptible to bank-cutting on account of being composed of loose gravel with about three feet of sandy soil on top. This condition, however, is favorable for the correction of the river channel here. It could be easily dredged out in any attempt to straighten the channel. The great loss constantly occurring in this region could be done away with, with less cost than that occasioned by the 1913 flood alone. Less than two miles of dredging would take the channel in a straight line from where it comes against the bluff in Section 22 to the straight stretch of the channel which leads toward the bridge in Section 20. It would take less than two miles on account of part of the old channel itself being within the straight line, and, therefore, able to serve. Undoubtedly this stretch of valuable valley land cannot be abandoned to the ravages of such profligate meanders as now occur, for very long in the future. Practically five hundred acres are unfit for use. With the river corrected, and taken care of when once corrected, these five hundred acres of practically worthless land would be worth one hundred and twenty-five dollars an acre in a very short time, to say nothing of the value to society in general of the amount such land might produce. A cost of two thousand dollars and a small annual outlay for taking care of incipient meanders would bring this practically worthless area to a selling value of $62,500 in a very short time.

For four or five miles below Paragon the river is relatively straight, having only a few incipient meanders that should be stopped by all means. The damage done here was slight. Not over twelve acres were denuded, while much of the region was silted, enhancing its value considerably.

The region below Limestone Creek to the vicinity of Romona must be mentioned in this report. It is a region of meanders which are past the incipient stage. They are likely to become still larger, but the damage they are doing now approaches the maximum. The first two little cuts (see Chart No. 3), one on each

side of the river, are incipient, and the damage done by them in the flood was slight. They deserve attention only for what they are capable of becoming. These little things neglected are the things that sometimes become alarming because of what they develop into.

In making the bend in the northern part of Section 2, the river has cut away as much as five acres in the past year. This land belongs to Mr. Benj. Gray. Mr. Gray, however, has gained as much land as he lost, by the river turning in the other direction below. The amount gained is a great bar as yet, and not equivalent in value to that lost. A cut-off was almost consummated, reaching from the bank cutting on Mr. Gray's land to the next meander which turns to the northwest and leads into Section 3. If this cut-off should take place, it would at least eliminate one meander, which would be all the better, although Mr. Gray would be a heavy loser. The meander which leads into Section 3, cut about three acres from the bank during the flood, but about twenty acres have been lost within the last ten years. A great sand and gravel bar lies on the inside of each of these meanders, each consisting of several acres, testifying to the waste land that a meandering stream can make. Without considering the two bank cuts below (just east of Romona) in which about three acres were lost, and the ten acres which were literally devastated by the over-running current nearby, the conditions call loudly for attention. The river could be straightened here, even in this bend of the valley, in such a manner as to eliminate the meanders. Although the valley is narrow, in the long run it would be much better for all concerned if something was done toward the end mentioned. Mr. Gray expressed his willingness to have this done if proper adjustments could be made. It appeals to reason that when sixteen acres are lost within one year, and within the past the conditions have been such that over one hundred fifty acres have been turned into a mere waste, some constructive measures should be taken.

In Owen County there are two or three places that might be given attention, for instance just below Spencer and just east of Freedom; but as a whole the valley is narrow and it would be more or less expensive to straighten the channel, even in these places. There is no doubt, however, but that conditions could be bettered, and with little expense damage done by bank cutting and denudation could be greatly mitigated.

A glance at Chart No. 4 shows that bank cutting in Greene County was very severe. It can be distinctly noticed that the

bank-cutting is in those stretches of river valley where the river has meandered extensively. The vicinity of Worthington is striking for its meanders. The large irregular loop to the north, one and one-half miles east of Worthington, is certainly needless and could be corrected with a small outlay in comparison to the value of the land it would redeem. But it is the series of long loops parallel to each other south of Worthington which attract most attention. In these long parallel loops eighteen acres of land was lost by bank-cutting, and over one hundred acres so cut and denuded that it cannot be used for farm land for many years to come. This is speaking of the damage done during the flood alone. Less than one and one-fourth miles of actual dredging would remove every one of these loops. The stream actually travels four miles to get one and one-fourth miles. If this straightening were done, there would be a long stretch of river from Worthington to near Bloomfield with the exception of one meander in Section 9, three miles northwest of Bloomfield. The meander which reaches westward in Section 33 comes against a sandstone cliff, and consequently no cutting occurred in rounding it. At this point the stream passes over sandstone in a series of rapids known as 'Rocky Ripple.' Another noticeable feature of this series of meanders is the remarkable width of the channel. It ranges from thirty to sixty rods in width.

Attention has already been called to the remarkable loop just below Bloomfield. There was but little land lost at this place; perhaps not over an acre in actual bank-cutting was carried away, but the loop itself has caused considerable land to be practically worthless. The neck of the meander is badly cut and denuded; it was cut more the year preceding the flood than during the flood. The short distance across the neck of this meander and the presence of the cliff on the left bank where the water would come against it in case a cut-off were made, present a practical situation where a cut-off could be made, thus eliminating a meander at little cost, much to the advantage of all concerned.

Chart No. 5, shows the conditions of the river between Knox and Daviess counties. As stated before, the river between these counties is practically a continuous series of meanders, beginning in the southern part of Greene County and ending at the junction with the East Fork. The details of no particular place will be given here, but special attention is called to the upper part of Chart No. 5. It would seem that cut-offs are incipient in many places, yet not a single one was made during the flood. Two were found which had been made within the past few years, but two other

places were found in which the river, having made a cut-off several years before, had reverted back to its old meander again. One of these latter places is just west of Elnora, and the other is about four miles above Edwardsport.

A fairly accurate estimate of the aggregate number of acres lost by bank cutting between these two counties during the year is seventy-five acres. Hundreds of acres are lying in idle sandy and swampy tracts within the inside bends of the numerous meanders. No fair estimate of less than twelve hundred acres could be made, entirely due to bank cutting, which has accumulated from past years. This land cannot be reclaimed short of straightening the channel, nor can the continued bank-cutting be stopped or mitigated with anything less. As yet this paper cannot do more than call attention to this phase of loss to society in general; but as has been intimated before, a loss of something like $300,000 in ten years between these two counties must be considered in the near future.

Of that part of the East Fork traversed, the only bank-cutting amounting to any considerable damage was found in Jackson County. (See Chart No. 7.) Even here it was not severe. From Brownstown to Sparksville, the only part of the East Fork in the extensive valley coming within the notice of the writers, there were not over twelve acres lost by bank-cutting. The channel from above Brownstown to near Medora is relatively straight except for two rather large meanders. Consultation of the chart will show that these could be remedied with comparative ease. The one between Brownstown and Vallonia almost effected a cut-off during the flood, yet there would necessarily be considerable dredging before the channel could be straightened at this point. The other meander, opposite Vallonia, would require considerable more dredging for its elimination.

Below Medora several meanders are well started, which will continue to grow larger; considerable damage by bank-cutting may be expected from these in the future. Between the junction of the Muscatatuck with White River and Sparksville, a series of remarkable meanders occurs. Considerable bank-cutting was done here, with the exception of the backward turning loop from Section 17 to 16, known as the 'Devil's Elbow.' At this place the river runs into the bluff, and, of course, can do no bank-cutting. There are places across this series of meanders where the river might be crossed three times within a distance of a little over a quarter of a mile.

Charts Nos. 8 and 9 show the river in the restricted valley

Fig. 42. Landslide that obstructed interurban and public roads, three and a half miles north of Martinsville.

Fig. 43. Landslide, Martin County.

region in which no bank-cutting occurred. In this region but little damage was done except that done to improvements and by denudation. As to improvements, there are but few to be mentioned outside of what were taken up in connection with levees and embankments. The steel bridge at Rivervale was destroyed, as shown in Figure 34. The dam across the river at Williams aroused much speculation in the minds of the writers as to its probable effect; but on careful investigation, absolutely no damage could be traced to it as a causative agent. It does, however, cause the water to be ponded as far back as the pumping station at Bedford, thereby making the banks lower than they were before. This will cause overflows to be rather imminent in the lower ponded region. The water even at low water mark, is ponded in the little streams which enter the river. This is well illustrated by the little stream coming in from the north just above Williams. (See Figure 41.)

It has been noticed that bank-cutting occurred in the constricted valley region of the West Fork, yet with much less intensity than in the wide valley regions. But it is a striking fact that none occurred in the constricted region of the East Fork. Why should it occur on the West Fork and not occur on the East Fork in similar valley conditions? Primarily, it is because of the intrenched meanders, and the stream's nice adjustment to them. The stream sweeps in great curves, just as the valley itself meanders, and keeps its outside bank a constant cliff which is not noticeably affected. In the West Fork region, the intrenched meanders are more or less irregular and broken and the stream is only rarely adjusted to them. The channel, therefore, meanders about over its narrow flood plain, doing considerable bank-cutting. A study of Charts Nos. 4 and 8, will verify the above statements.

Of that part of White River valley traversed in the investigation of the flood conditions, an aggregate of one hundred sixty acres was lost by bank-cutting. This total is fairly accurate. Figuring at the low price of seventy-five dollars an acre, $12,000 were lost in land. The value of these one hundred sixty acres for the ten years lost to the State would be $48,000. This makes a total of $60,000. Since bank-cutting is relatively the same each year, on account of its taking place under any condition above low water mark, it might be estimated that ten times (twenty times is perhaps nearer correct) this loss is continually placed upon society on account of bank-cutting. This would make a total of $600,000. From the proportion of the amount of water carried by other streams, ignoring the minor streams, to that of White River, (the part in-

vestigated), their proportionate length, and counting bank-cutting as one-half as much in the northern part of the State, on account of the relative ability of the soil of the glacial region to withstand bank-cutting, a fairly accurate estimate of the total bank-cutting of the entire State during the flood of 1913, would be eight hundred fifty acres. This is not counting the Ohio River at all. The estimate in land loss for the State would be $63,750. The loss to society because of lack of production for the minimum ten years would be $255,000. The total loss, then, for the year of the flood would be $318,750. The total loss to society for the entire State (figuring the loss as accumulating for the minimum ten years) would be $3,185,500. But this total estimate is far too low. This is figured on a total ten-year loss due to bank-cutting of 8,500 acres, which is probably fairly accurate, but there is far more land than that lying idle due to bank-cutting. It was estimated that at least 1,200 acres were idle due to bank cutting between Daviess County and Knox County alone. It is evident, then, that the total estimate is far too low; an estimate of from two to five times the amount would be more nearly correct.

Now, since sufficient details concerning bank-cutting along White River have been given to get a grasp of the situation, and since some idea of the immediate and cumulative loss is before us, let us consider what might be done either in stopping such a loss, or in mitigating it. The writers are not of the opinion that the entire river channel should be straightened nor any large part of it, but they do think it not only feasible, but advisable to straighten certain portions of it, as has been brought out in the above discussion. Many farmers who own land in the valley were consulted, and the majority were of the opinion that the river channel could be profitably straightened in many places. They think that the river should be improved at the expense of the people that are benefited. Their annual losses would in a very short time be enough to pay for the improvement of the channel; and if a small tax were levied on all of the landowners in the region coming within the scope of the benefit, to furnish funds to keep the banks protected where there is a tendency for them to be washed by the current, and to keep the channel free from obstructions that are liable to cause the current to be deflected against the bank, the situation would be practically within control. As has been emphasized, not only the land which is lost annually by bank cutting might be saved by preserving a straight channel, but the waste land already made by bank cutting could be redeemed. This straightening of

FIG. 44. Montgomery barn, west of Williams, showing river at highest stage.

FIG. 45. Montgomery barn, water partially subsided.

the channel would cause the velocity to be increased, which in turn would lower the channel, making it possible for it to carry more water in times of flood without overflowing the banks. A destructive flood in the growing season would cause a damage equal to the amount necessary for such improvements as mentioned above. However, destructive floods in the growing season are not the rule in the White River valley, but they are a possibility which is staring the farmers in the face all of the time, and there is no way of predicting just when the valley land will be flooded. In another place the writers have shown that the majority of the floods in the Ohio valley occur during the first four months of the year; but that does not hinder the flood waters from cutting into the banks, or washing the soil from the flood plain. One farmer pointed out the fact that in one way, at least, the floods that come the first four months are more destructive to the soil than those that come in the dry summer months. If the ground is not frozen when a flood comes during January, February, March or April, the ground is looser than it would be in the summer months, and hence more easily washed. Freezing and thawing are the causes of this looseness of the ground. In the summer months the ground is likely to be dried out and to be harder and less easily eroded. The ground that is under cultivation during the summer months, of course, will be badly washed. An overflow at any time of the year is sure to cause a large amount of damage, but by straightening the channel the increased fall will cause the current to cut the channel deeper, thus lessening the need of levees, and carrying the water off in a much shorter time.

But straightening the channel does not stop bank-cutting. It may mitigate it for a short time, but if that is all that is done, in a short time conditions would be as bad as before. As has been said, the current must not be allowed to come against the bank in such a manner as to start a meander. In a straight stretch of the river let no meanders get started. If they by some means occur, steps should immediately be taken to keep them from growing larger. Many places came under the notice of the writers where rock had been thrown along the bank to prevent further bank cutting. These banks, riprapped thus with refuse rock, were not cut in the least by the current. At other places, piling had been thrown down and brush and other debris packed in behind. Below Spencer, in a very decided meander, rock jetties had been extended out in the river some twelve or fifteen feet. Rock was also thrown on the bank to prevent the current from cutting around the jetty.

These, too, were very effective, and relatively inexpensive. Any of these methods could be reinforced by planting trees along the bank, and these after a few years would protect the bank very effectively. Sycamores and willows are undoubtedly the best trees to plant, as they both have an extensive root system and grow very rapidly. The writers are of the opinion that tree planting should go hand in hand with the above measures.

Landslides Due to Excessive Rainfall

Professor Culbertson at the Indiana Academy of Science, at Indianapolis, October 24 and 25, 1913, in his report on the flood conditions of southeastern Indiana, shows that the continued heavy rainfall caused the soil on the steeper slopes to creep and slide to a considerable extent. Landslides in White River drainage basin caused very little damage. Figure 42 shows a small landslide that occurred about four miles north of Martinsville. Here a considerable pile of earth slid down and obstructed the public road and the interurban track. As can be seen in the plate, small trees were growing in this portion of earth that slid into the public road. Whether growing trees have a tendency to cause or aid in the development of landslides by permitting the water to penetrate into the ground more easily, the writers are not able to say. It seems that trees with extensive roots would help to hold the soil from slipping.

Figure 43 shows where the soil has slid on a steep Knobstone hill, in the same locality. This particular part of the hill was free from trees. Other parts of the hillside that were steeper but upon which trees were growing were free from landslides. On the whole, it seems that it would be better to permit forests to grow on the steeper hillsides, especially those that are too steep to farm; for a removal of the trees will surely help along erosion. In neither of the above cases were there more than very small trees and shrubs to protect the soil.

Shortening of the Course of Bean Blossom Creek

Bean Blossom Creek flows into the West Fork of White River below the Monon Railroad bridge at Gosport. It is of minor importance, but it is interesting to note that the course of this creek will be shortened by at least 500 feet in the near future. By looking at Chart No. 3, the relation of the creek to White River

is seen at a glance. At present there are some 15 or 18 feet of land between the waters of the two streams, 500 feet above the present mouth of Bean Blossom.

Reconstructional Measures and Their Cost

The investigation of the flood results, in itself, gave only an idea of the amount of damage done, with a bare guess as to the probable cost of replacing the structures damaged or entirely destroyed. Accordingly, a little more than a year after the flood a second investigation was made with the end in view of ascertaining the cost to the counties concerned of reconstructing and repairing roads and bridges, the cost to the towns due to flood damage, and the cost to the railroads in rebuilding impaired or destroyed structures. It must be understood that this investigation could not bring the exact costs or expenses incurred by the different bodies, due to the flood alone, to an exact total, because more or less repair work would have been done regardless of the flood; because all the reconstruction work is not yet complete; and because only rough estimates could be procured on a greater part of the work. No attempt was made to ascertain some of the greatest losses, such as those occurring to individuals personally, and to corporations, including loss in traffic to railroads, and losses due to idleness of factories on account of the lack of material, etc. The figures given refer strictly to objective measures. The detailed conditions of practically all of the embankments and bridges are given in the discussion of levees and embankments and will not be repeated here. Attention is called to that part of the discussion for such details.

Morgan County, as has been brought out in the part dealing with levees and embankments, was a heavy loser on account of the flood. The public road and grade and the approaches to the bridge at Waverly were rebuilt at a cost of $1,200. (See Figure 21, for the condition immediately after the flood.) At Henderson bridge, where great damage was done to the high public road embankment across the valley, the cost went far into the thousands. It was found necessary to build another span to the bridge one hundred seventy-five feet in length, where the current had widened the channel on the south side. This span of bridge cost $9,000. The high grade was replaced as it was before, at a cost of $3,800. As has been said on a preceding page, the damage here was almost entirely due to the insufficiency of the opening under the bridge.

FIG. 46. Montgomery barn after the water had withdrawn. The water washed a hole under the corner sufficient to wreck the barn.

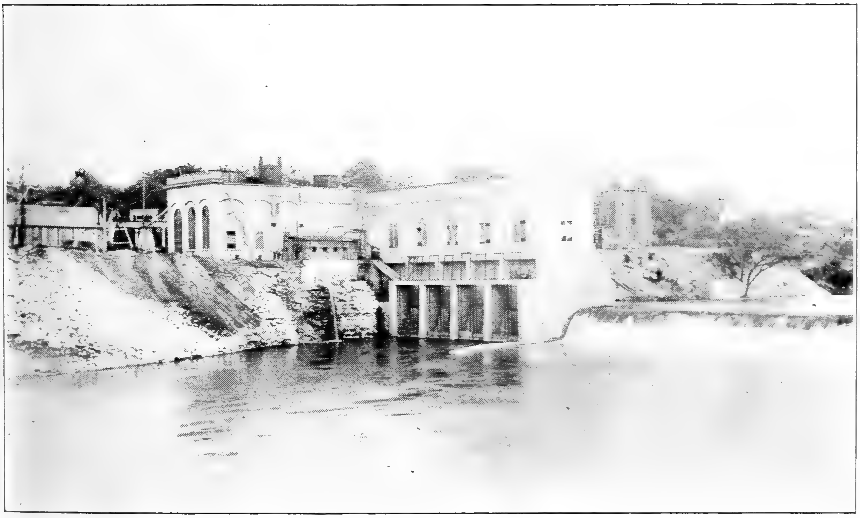

FIG. 47. Power plant at Williams, Ind.

This condition has been remedied by the new span of bridge, making the opening at least one hundred feet wider than it was before the flood. The passage way under the bridge now seems to be sufficient for any future flood approximating the last one.

Outside of the immediate White River valley, the county had expenses totaling $8,000. A bridge across Scott's Creek, above Martinsville, four miles from the river, cost $3,500. The grade across White Lick Creek, west of Mooresville was repaired at a cost of $700. Elsewhere over the county the repair work amounted to $3,800. Thus the total expense to the county itself was $20,000.

The road leading northwest from Martinsville across White River valley was washed out. The part between the river and the city of Martinsville, a stretch of 3,900 feet, has been replaced by pavement. This structure is undoubtedly flood proof. Pavement brick slushed with cement has been laid upon an eight-inch concrete bed. Curbing on a level with the pavement has been sunk three feet into the ground on each side. Cement sidewalks three feet wide have been placed on each side of the curbing. The entire structure is more than thirty-three feet wide. It was built by Washington Township and the city of Martinsville at a cost of $20,000. (See figure 47.)

It was found almost impossible to get the exact cost to the railroads of their repair and construction work within the area investigated. The amounts given, therefore, are estimated; they are rather conservative, as the writers have no intention of exaggerating the actual conditions and losses. Mr. Carmichael, section foreman of the section west of Martinsville on the Vandalia Railroad, estimated that the cost to put back the grade and track of the one and one-half miles washed out, was $10,000, and that the one and one-half miles north of Martinsville cost an equal amount. The Interurban Line was injured as much, if not more, than the Vandalia Railroad north of Martinsville; therefore, a safe estimate of the expense to the Interurban Company would be $10,000.

The city of Martinsville itself suffered considerably during the flood, since the water ran swiftly through the main streets. No houses were actually carried away, although the water was in several hundred of them. Damage to the furniture could not be estimated unless a house to house canvass was made, and even then it could only be approximate. Mr. J. W. Anderson, the present mayor, estimated that the expense of the city in taking care of the people, in feeding them during the flood, in cleaning up the streets after

the flood had subsided, and in paving a small stretch of one street that was torn up, was not less than $10,000.

This completes the items of cost coming within the scope of Morgan County. The total estimated expenditure of all the corporations which were injured by the flood was $80,000. This is perhaps as accurate as it is possible to get at present.

Owen County was exceedingly fortunate in the matter of damage to county structures. No county bridges or road-grades were washed out in the White River region. The grade and approach to the river bridge at Spencer was repaired at a cost of $300, and the approach to the bridge at Freedom was repaired at a cost of $100. This total of $400 is rather small in comparison to the cost in several other counties.

The railroads in the county, however, were not so fortunate as the county. The estimated cost to the Monon at Gosport was not less than $8,000 in rebuilding the half-mile of grade and track and in repairing the injured pier at the bridge. The Vandalia in Owen County was not injured very much in any one place. In the 'Narrows' above Spencer, some of the track was turned over and the grade slightly washed. A small portion of the grade and track was washed at Freedom. The estimated cost to the company to repair the above damage is $5,000.

The town of Spencer was flooded in the part next to the river. Little damage was done outside of wetting furniture. Altogether, four houses were moved from their foundations; one house across the river was carried entirely away. This private loss was in the neighborhood of $2,000. The cost to the town of cleaning up the streets after the flood, in repairing sidewalks, and other incidentals was about $1,000. These estimates were given by Mr. Steven Summers, a member of the town board. The total estimated loss in the entire county was, therefore, $16,000, a small amount as compared with the preceding county.

Mr. C. H. Jennings, Auditor of Greene County, gave the total cost to the county in repair of roads, rebuilding of bridges and grades, etc., as $40,000. Of this amount, $10,000 was spent for bridges. The county bridge west of Bloomfield was being repaired at the time of the flood, and several hundred dollars damage was done which had to be made good by the contractor. Special attention was given to the county road-grade west of Bloomfield. This grade was repaired at a cost of $2,300, but it was graded down two feet lower that it was before the flood. On top of this grade has

been placed a concrete pavement eleven inches thick, twenty feet wide, and four thousand four hundred feet long. This pavement cost the county $3,300. This embankment across the valley is built on a water level line, about seven feet above the valley land at the bluff and twenty-five feet above it near the river. It will average perhaps twelve feet above the valley land. There is nothing to protect the embankment but the pavement on top. Should the water rise approximately as high as it did in 1913, the water would pour over the embankment its entire length and undermine the concrete on the lower side. In order to make this embankment flood proof, some sort of an apron must be made on the lower side to prevent the water from cutting under the pavement. This undoubtedly should be done or the present structure is in serious danger. The cost of building a cement apron on the lower side of the embankment would be probably as much as has already been expended upon it, but it certainly seems necessary. Such a structure is far more in danger of destruction than one built on a level with the valley as is the case at Martinsville.

The grade at Newberry has been rebuilt and the abutments of the small bridges replaced.

The town of Worthington was inundated on its western side by the overflow from Eel River. No houses were washed away, but a great many were badly flooded, ruining much furniture and household goods, thus causing considerable personal loss. The loss of the C. & E. I. R. R. was about $1,200, where the flood waters broke over the embankment allowing the western part of Worthington to be flooded. The C. & E. I. R. R. was injured at two other places in Greene County. About one-half mile of track and grade was taken out near where it crosses Lattas Creek, northwest of Bloomfield, and below the river bridge north of Newberry over a mile of track and trestle was taken out. The estimated cost of repairing these two places is $7,000.

The I. C. R. R. with its long stretch of high trestle work across the valley west of Bloomfield received but little damage. (See Figures 26 and 27.) An estimate of $2,000 would be rather high. But the Monon Branch received severe damage. The estimated cost of repairing it is $7,000, and it is yet in a very bad condition.

The total estimated expenditure for all the structures in Greene County and the repair work is $57,200.

Daviess County itself sustained but little loss in the White River region. A bridge in Washington Township which had not been completed was injured some, and the loss fell on the Vincennes

Bridge Company. The great loss in Daviess County was received by the B. & O. R. R. Co. It is impossible to get more than an approximate estimate of what it cost to replace the bridge across the river, four and one-half miles west of Washington. Nearly a hundred men were employed for over eight months. It took nearly all summer to build the pier in the middle of the river. This pier is built on bed rock sixty-five feet below the surface of the water; at its base it is forty-five feet wide, and is long enough on top for a double track. The butments of the new bridge were set back some twenty feet, making the opening under it some forty feet wider than formerly. The new bridge is approximately six hundred feet in length. This bridge could not have cost the B. & O. R. R. Co. any less than $100,000, and may have cost much more. A mile and a quarter east of the river bridge is 'Blue Hole,' where about four hundred feet of track and trestle went out, and with it a train which was being used in placing sand bags on the grade between there and the river. The waters must have rushed through this opening with tremendous speed and force. The hole, for it is a hole, is 350 feet wide, 700 feet long, and 40 feet deep. In the rebuilding of the trestle, carload after carload of rock ballast was dumped into the place, so that now it shows above the water under the trestle. The engine that went down in the hole was afterwards raised and now is in service in the yards at Washington. 'Blue Hole' was started in the flood of 1875, and has given more or less trouble ever since. It was made about twice as large during the last flood as it was before. Evidently, it cost the B. & O. R. R. Co., several thousand dollars this last year, no less than $6,000, considering the large squad of men they had hunting for two weeks for the bodies of the men drowned in the flood.

The total estimated expenditure, then, by the B. & O. R. R. Co. in Daviess County is $106,000, and it was probably much more. The bridge replaced, however, is much better than the old one. The extra forty feet opening will be a great help, but it would undoubtedly have been much better and safer to have had the opening made much wider through the use of trestle work. The grade through the valley was so high that the water never got above it at any place, but was forced to go through the few narrow openings. The concentrated force of the waters is what caused the damage at the river bridge and at 'Blue Hole.'

The C. & E. I. R. R. Co. lost about one-half of the bridge on the East Fork, between Washington and Petersburg. As yet they have not replaced it, but are carrying on traffic over a tem-

porary trestle-work. The cost of building a bridge here would be much less than the one west of Washington. The river flows over bed-rock at this place; it is near the bluff line. A bridge could be built easily for $50,000.

Martin County will be considered next. The repair of county structures was limited to the grade and sidewalks in West Shoals in the White River region. The expenditure here was $300. The town of Shoals itself suffered more than any other town in the area investigated. Forty-four houses were moved from their foundations, eleven of which were carried down the river. Nearly all of these houses were situated in the old valley (see special plate), east of Shoals, where the water swept around the town, washing out the B. & O. R. R. grade. None of these houses were fine residences. Hon. H. Q. Houghton, who was chairman of the Relief Committee, estimated that the entire personal loss was $30,000. The Relief Committee used $4,500 in replacing, remodeling, and refurnishing the houses. Some kind of a house was replaced in the place of each one that had been moved by the flood waters, with four exceptions. The families of these four showed no interest or disposition to help, and were passed by.

The B. & O. R. R. Co. lost about one and one-half miles of grade and track at Shoals and some two miles below. The replacing of this grade and track cost not less than $10,000. The grade was rebuilt in a veritable levee across the old valley in the eastern part of Shoals, ready to be washed out again by the next flood approximating the recent one.

The entire value of all that was lost within the White River region of Martin County is estimated at $40,300. This includes the estimated $30,000 loss to the inhabitants for whom $4,500 was spent in replacing their structures. But since the $30,000 loss is the ultimate loss, these figures are counted.

Lawrence county was far from being fortunate in the way of losses to county and railroad structures. The county bridge at Rivervale was replaced at a cost of $16,484. The span added to the south side of the bridge below Bedford on the Bedford and Mitchell pike cost $4,250. The bridge, which was carried fifty feet up stream by the rapid rising back waters, about one-half mile from the river up Guthrie Creek, cost $3,305. The Salt Creek bridge cost $5,150. The cost to the county in the way of road repair on account of loss due to the flood was about $3,000. The total expenditure of the county itself, therefore, was $32,190. There

Fig. 48. Power plant at Williams when the flood was highest, 31.12 feet above the crest of the dam March 29.

Fig. 49. East end of the dam at Williams. The hole was cut by the flood in January and was made very little larger by the March flood.

were other expenses, however, incidental to the reconstruction work. These figures are merely contract prices.

The B. & O. R. R. Co. had one-half mile of track and grade washed out at Rivervale. The bridge remained intact. The estimated cost of reconstruction here is $4,000. The branch line of the B. & O. from Rivervale to Bedford also met with considerable damage where it crosses the river below Bedford. Over one-half mile of track was removed and about two hundred feet of grade. The total expenditure on the entire branch was perhaps $4,000.

The Monon was a heavy loser, both in the White River stretch and in the Salt Creek region. At White River below Bedford, about one-half mile of track was taken away, a small part of the grade was washed out, and the bridge was slightly injured. The cost here was probably $3,000. In the Salt Creek region north of Bedford about a mile of track was taken out and the grade was badly injured. The cost in this region was not less than $4,000.

Thus, the entire estimated amount spent in the confines of Lawrence County for reconstructional purposes was $47,190.

Jackson County, with its wide valley expanse in the region above Brownstown and Seymour, and the valley of Muscatatuck River, was the heaviest sufferer in the way of expenditure for reconstructional measures. Practically two hundred miles of pike roads were badly damaged and some fifteen miles were entirely destroyed. Mr. Albert Luedtke, County Auditor and a former contractor, estimates that the county will be forced to spend $50,000 for roads, and $25,000 for bridges. He gives these figures as the lowest estimate that could be made. These figures include the $6,000 for the construction of a concrete road from the lower edge of Brownstown to the river, a stretch of a little over a half mile. This road will be similar to the concrete road at Bloomfield with the exception that it will be built on a level with the valley and instead of being built on an embankment or levee. This will undoubtedly be much better, as it will be flood proof. The waters can pass over it, and have no opportunity to do it any damage.

The B. & O. R. R. was a heavy sufferer in Jackson County. About one and one-fourth miles of grade and track was washed out at Medora. The estimated cost of replacing this is $8,000. The pier of the river bridge was washed out, and it was found necessary to build an entirely new bridge. The steel structure of the old bridge is still lying in the river. The estimated cost of this bridge is not less than $50,000. Much trouble was experienced in putting in the pier and the cost may have been much more.

The Southeastern Indiana Railroad suffered considerably in the stretch across the wide valley west of Seymour. Not less than three miles of track was washed out, several short stretches of trestle taken away, and the grade badly washed. The damage approximated $20,000.

The town of Medora suffered considerably on account of the water getting into the houses and damaging household property. No houses were moved or injured otherwise. The personal damage to the town does not come within the scope of this part of the report, since it treats of the reconstruction work mainly. Furthermore, the personal damage is very difficult to estimate in dollars and cents.

The total estimated expenditures in Jackson County reached higher than in any other county coming within the area of investigation. They amount to a total of $152,000.

The expenditures for reconstructional work in the various counties investigated in brief are as follows.

Morgan	$80,000
Owen	16,300
Greene	57,200
Daviess	106,000
Martin	40,300
Lawrence	47,190
Jackson	152,000
Total	$498,990

Practically ninety-five per cent of the above half-million dollars was spent by corporations. While this money was a direct loss to the corporations and the people as a whole, such a loss is not at all to be compared to the personal losses that were suffered along the river by the private individuals. The losses to the individual land owners, as has been partially brought out elsewhere in this report, mean far more, so far as actual suffering is concerned. Loss of crops, live stock, household goods, and buildings gave individual injuries that in some cases will never be recovered from. It is to be lamented that such losses cannot be much more than guessed at; and again should they be approximated, they would seem small in dollars and cents as compared to the losses that have been given. They were individual, and generally to individuals who could ill afford any loss at all. Renters in some parts of the valley lost practically all that they had. Everyday laborers in the towns, such as Shoals, lost practically all that they possessed. The things in themselves may seem very little, but to the individuals, their loss left the future very dark and gloomy indeed.

Relation Between the Flood and Sickness

The advent of any considerable flood upon a town or city is sure to cause a great amount of anxiety, for in the past it has always brought with it an increase of disease and sickness. This statement is borne out in the newspaper clippings of the preceding pages which were written after the flood of August, 1875. It has been impossible to find out whether or not there was an increase in disease after that flood, but such must have been the ordinary consequence of a flood, or the suggestions referred to would not have been made at that time.

Several letters were sent out to the health officers of the various cities that were partly inundated, asking about the sickness that occurred as a result of the recent flood. Some of the representative letters received in reply are herein duplicated. It was with considerable surprise that the tenor of these letters was noted. It was fully expected that there would be a notable increase in disease in the parts of these cities and towns that were inundated. The results were just the opposite. The possibilities were there, but the health officers arose to the occasion and clearly demonstrated that disease of a contagious nature can be wiped out of existence even under the most adverse conditions due to a flood. Would it not be a good investment for such action to be taken even when there are no floods? Human life is as dear at one time as another. It is shown that it can be conserved, hence it is our duty to take measures along that line, and make even more progress than we have made in the past. If a man is imprisoned in a mine, there is no limit to the amount of money that will be spent to rescue him. The last flood showed that there are many lives lost each year by disease that could be saved, if such energy as was exerted after the flood were to be continued for the same length of time each spring. It appears that this is one of the most important facts that has been brought to light by the investigation of the flood conditions of White River, and it is hoped that a little of this sort of energy will be spent each spring in cleaning up the poorer districts of our towns and cities. As a rule, the flooded districts are inhabited by the poorer class of people, living under improper hygienic conditions. If these conditions could be righted each spring, much less disease would prevail, and loss of life would be considerably curtailed.

Noblesville, Ind., December 5, 1913.

Dear Sir:

Your favor of 4th inst. at hand. Immediately following the flood and for some time after, we had a force of men working to clean the district over

which the water had ranged. Free disinfection was given in all parts of the city and everyone was compelled to clean cellars subject to the approval of the Health Department before they might return to their homes. In addition, free typhoid immunization was offered and taken advantage of. Consequently there was reported during the month of April, only one contagious disease, namely scarlatina, and that could in no way be attributed to the flood. As to the general state of health following the flood, my inquiries among the physicians lead me to believe that in the city there was little or no effect. Typhoid has been a minus quantity with us this year and the consensus of of opinion among all is that the most that could possibly be attributed to the flood in this vicinity only includes a few attacks of tonsilitis with the consequent rheumatism. Across the river from the city have occurred two cases of diphtheria that might possibly be connected with it.

Any further information that I may be able to give will be tendered very willingly if you will only let me know.

Yours most sincerely,

H. H. Thompson, M.D.

Shoals, Indiana, Nov. 29, 1913.

Dear Sir:

In reply to your inquiry I beg to say that there was not as much sickness following the last spring flood as was usual in this community in previous years. I am unable to account for the unusual healthful condition that prevailed here all summer in comparision to other years.

Respectfully yours,

Chas. E. Stone,
County Health Commissioner.

Indianapolis, Indiana, Dec. 5, 1913.

Dear Sir:

There has been less sickness in the flood district during the last year than at any time for several years.

Diphtheria, scarlet fever and other infectious diseases have been fewer this year than for the past two years. During the fall months, typhoid fever, the disease which you would naturally expect to make its appearance as a result of the unsanitary conditions left by the flood, is not as prevalent in that district as in other parts of the city. If fact, all sickness shows a lower rate in that part of the city than during the previous two years. This may be attributed to the fact that a concentrated effort was made to clean thoroughly the flooded district and leave it in as perfect sanitary condition as possible.

When we finished the work, I made the remark that West Indianapolis was in a better condition than it was before the flood. I believe that the statistics on disease in that district would bear this out.

Yours very truly,

H. G. Morgan,
(Health Officer.)

SPENCER, INDIANA, December 4, 1913.

Dear Sir:

Replying to your inquiry of this date, I will say that there was very little sickness occurring in this community that could be attributed to the flood. In the four months immediately following the flood there was less sickness in Spencer, than for the corresponding time in any year for the last twenty years.

Very respectfully,

ALLEN PIERSON, M. D.,
(County Health Officer.)

FLOOD OF 1875 COMPARED WITH THE RECENT MARCH FLOOD

The flood of 1875 came in the last days of July and the first days of August. It was of about the same height as the recent flood. Coming in August, it caught the crops, corn, wheat and oats, and caused much more damage than the March freshet. There are many conflicting reports of the relative stages of the two floods. A number of reports showed that the August flood of 1875, was twelve or eighteen inches higher than the March freshet. About the same number showed that the last flood was as high, or higher. These conflicting reports may be explained as follows: During the last thirty-eight years there have been many obstructions, such as public roads being graded up, interurban grades, and steam railway grades. In each case the man above the obstruction declared that the March flood was the higher while the man below the obstruction was very sure that the flood of August, 1875, was the higher.

The reports between the obstructions showed that the two floods were about the same height. By the occurrence of the recent flood in March, there was no space taken up with green vegetation and growing crops. There is much less timber in the White River bottom now than thirty-eight years ago. So, on the whole, there seems to have been considerable more water passing down the West Fork last spring than in August, 1875. The flood of 1875, on the East Fork was not in any way to be compared with the recent freshet, which was from seven to ten feet higher than any previous high waters.

The following newspaper reports will give some idea as to the conditions of the floods:

(Special to the Indianapolis Journal.)

MARTINSVILLE, IND., August 6, 1875.—The waters here are subsiding. White River is slowly falling, but it will be several days yet before it is within its banks. Running as it does through the best portion of the country—through

the great corn and hog section—its damage to our farmers and people is immense. Acres of fine growing corn and wheat in the shock that a few days ago gladdened the hearts of the grangers who possessed it, are ruined and wholly lost. All the creeks and other small streams have been flood high, inundating whole farms, thereby destroying crops, carrying away fences, and doing other damage. Many of our roads have been rendered impassable and the bottom land stripped of the fences. The loss of Morgan County by rain and flood will not fall below a million dollars, and all kinds of trade and business will be stagnated for the next twelve months. The Vincennes Railway here and for several miles above and below, is badly damaged and it will be several days before it will be in condition for the regular running of the trains. Large quantities of old corn stored near the river have been washed away and otherwise damaged by the raging waters. The wheat, oats and hay in the highland have been badly damaged by the late rains.

(*Special to the Indianapolis Journal.*)

SHOALS, IND., August 3, 1875.—The rains in Randolph County, which from the head waters of the East Fork, raised the river from ten to twelve feet, in many places filling the banks to their utmost capacity. The storms Saturday night and Sunday, in which water fell in Martin County to the depth of four inches, have completed the disaster. It is useless to speak of the crops; they were unusually promising, and now they are destroyed. As a result of the inundation the sandstone bluff on which Shoals is built, is an island.

Indications are that the river once ran east of the town, along the level bottom lands. It is supposed that some convulsion of nature changed it to the west side. The water is over the site of the old channel. To make this more complete, an ambitious creek joins with its waters. Fields of corn and wheat are covered, fences are washed away, and the lives of the residents are endangered. Ingress and egress are to be obtained only in canoes or on the railroad.

It is feared that the back waters in time will be productive of much sickness. Thousands of acres of land are covered with water in this portion of the county, the water reaching to the branches of the trees in the forests, in the bottom land. The water is still rising at the rate of an inch per hour.

In January, 1847, in June, 1856, and in September, 1866, the East Fork was exceedingly high, but the greatest damage attends the present overflow on account of the crops.

(*Indianapolis Journal, August 7, 1875.*)

No one who has not passed over the track of the late flood can form an adequate idea of the vegetable decay that it must produce. All along the river and its tributaries the weeds, as well as the good part of the crops are 'cooked black,' wilted, and sure to rot in the hot sun and remaining moisture so fast as to create a general miasm. Already the black water of the 'Old Bayou,' next to the Vandalia Railroad is covered with that thick green scum that says, malaria, chills and fever, as plain as if every shoot of fungus were a tongue. This is but one of a myriad ponds left by the retreating waters. A great deal of corn is washed or broken down, and its decomposition, as well as that of the overturned oats and grass, and the soaked logs, and refilled swamps, will swell the dangers of infection.

(Special to the Indianapolis Journal.)

SHOALS, IND., August 9, 1875.—White River at this place has been higher at this time than at any other rise. The back water has entirely surrounded Shoals, as previously reported, attaining a depth of seven to thirty feet. Yesterday the river began falling. The prospect is not very cheerful, as the smell of rank vegetation is very perceptible. It is feared that sickness to an unusual extent will prevail. Two hundred families were compelled to move from their homes, situated for the most part in the valley east of town, and partly in the furnace village of Irontown, a mile up the railroad.

(Indianapolis Journal, Saturday, July 31, 1875.)

THE FLOODS OF 1828 AND 1847.—The flood of 1828, which old settlers considered the highest ever known, washed a region wholly destitute of population and production, and the injury was comparatively light, although serious enough, we believe, to induce the legislature to remit the taxes or to extend payment on the inundated lands. The flood of 1847, it will be remembered by the older class of citizens, came nearly up to the flood of 1828, but not quite. But even at the later period, White River Valley did not contain more than one-fifth of the population that it does now, and only a little more than one-fifth of the wealth, as is shown in the comparative tables of the census, and the recent estimates of the Board of Equalization. The inundation, therefore, though larger than the present one by two or three feet, could not have done more than a small proportion of the harm done by the recent flood.

(Special to the Indianapolis Journal.)

WORTHINGTON, IND., August 5, 1875.—As the flood is the only thing talked about in this locality, I have concluded to furnish you a few items in regard to it. It was the highest and the most disastrous freshet ever witnessed by the oldest inhabitants. It was twelve inches higher than it was during the memorable flood of January, 1847, on White River and Eel River. Our town has been situated on an island for four days, the water being from six to sixty feet in depth in all directions. Work is suspended. All corn and wheat on White River bottom, in Greene County, for a distance of twenty-five miles have been swept away and nothing has been saved. In addition to all of this, all of the fencing has gone down the river with the products of the soil. The crop on the prairies is a total failure, due to the wet weather. It has been estimated that the damage in this county alone to the crops, and by the loss of fencing, lumber, etc., will amount to $300,000.

PART III.—FLOOD QUESTIONS

Increase of Floods

Are floods increasing, and if so, why? Leighton, in 'Water Supply Papers No. 234,' answers the question with a very emphatic affirmative. He bases his statements on the results of observations extended from 1875 to 1907, upon the Ohio River, the Allegheny River, the Monongahela River, the Youghiogheny River, the Wateree River, the Savannah River, the Alabama River, and the Connecticut River.

In the region studied, he gave the cause of floods and the cause of the increase of floods as follows:

1. Climate (including rainfall, evaporation, temperature, wind and humidity.)
2. Topography.
3. Geology.
4. Vegetation. (Deforestation, growing crops, etc.)
5. Artificial agencies (including breaking of dams, drainage, etc.).

He says, 'Summarily, therefore, it may be stated with confidence that the increase of flood tendency is due by far the largest measure to the denudation of the forest areas.'

It seems that, in Indiana, the deforestation of between 80 and 85 per cent of the total area of the State has had something to do with the increase of flood frequency and flood height. This is especially true of the southern part of the State, where the slopes are more steep and the country more broken. According to F. A. Miller and E. E. Davis ('Eighth Annual Report of the Indiana State Board of Forestry,' 1908), the most noticeable change in the activities of the Wabash River due to deforestation is the fact that it rises and falls more rapidly now than formerly. In three or four days it reaches a height that formerly took two or three weeks; however, the fall of the flood crest is now sudden, as the rise. Some seem to think that deforestation will cause the rainfall to decrease, or, if not decrease, to be distributed more unevenly through the year. This has not been satisfactorily proved. However, the following discussion will give the reader some idea as to the nature of the work that is being done in trying to arrive at some definite conclusion. Dr. Raphael Zon in *Science* (N. S. Vol. XXXVIII. No. 968), shows that there is a close relationship

between forests and precipitation. He uses the forests and precipitation of the eastern half of the United States to illustrate his point.

Dr. Zon starts his discussion by bringing up the fact that the eastern half of the United States receives its rainfall from the air currents that come from the Gulf of Mexico and the adjoining ocean. He then cites the work of the noted European meteorologist, Professor Bruckner, who has computed the amount of water evaporated from the land surface and the ocean surface, and the amount of water that is returned to the land and the ocean in the form of precipitation, and who has shown that the regions at the periphery of the continents are able to supply seven-ninths of their precipitation by evaporation from their own areas. In other words, the humidity derived from the ocean is precipitated in a narrow strip along the coast and even there consists of only about two-ninths of the precipitation falling in those regions. This being the case, Dr. Zon suggests that the air currents from the gulf region, upon leaving the coast, drop the humidity acquired over the Gulf, and, as they pass farther north gather up a new supply of moisture which will be precipitated farther on. If it were not for the evaporation taking place on the land, all of the larger continents would have large desert regions at their interior.

Then Dr. Zon cites the results of the researches of Professor Henry, in his recent investigations on the effect of forests upon ground waters in level country and the work of Dr. Franz R. von Höhnel, of the Austrian forest experiment station at Mariabrunn, who have shown that a forest area returns a large amount of water to the atmosphere. Then Dr. Zon says: 'The most valuable and complete work on the subject is by Otozky, a Russian geologist and soil physicist, which appeared as a publication of the forest experiment stations. Otozky worked up an enormous amount of observations, both his personal and those furnished him by other people, and did not find a single contradictory fact. His conclusion is that the forest, on account of its excessive transpiration, consumes more moisture, all other conditions being equal, than a similar area bare of vegetation or covered with some herbaceous vegetation.'

He continues the discussion as follows: 'If the present area occupied by forests in the Atlantic plain and the Appalachian region were instead occupied by a large body of water, no meteorologist would hesitate for a moment to admit that the water surface has a perceptible influence upon the humidity of the central states

and the prairie region. Should not, therefore, forests which give off into the atmosphere much larger quantities of moisture than a free water surface, have at least a similar influence upon the region into which the prevailing air currents flow.'

Then follows the interesting studies made by Professors Francis E. Nipher and George A. Lindsay on the rainfall of the State of Missouri, and the discharge of the Mississippi River at St. Louis, and at Carrollton, Louisiana. To quote from his article: 'Nipher found that the average discharge of the Mississippi River at St. Louis during the ten years ending December 31, 1887, was 190,800 cubic feet per second. The amount of water falling upon the whole state during the same interval was 195,800 cubic feet per second, or within two per cent of the discharge of the Mississippi River at St. Louis. If, however, a comparision is made between the total rainfall on the basin draining past St. Louis, and the river discharge at that point, it appears that the drainage area of the Mississippi and the Missouri Rivers above St. Louis, is 733,120 square miles, or over ten times the area of Missouri. These figures show that a small portion of the total rainfall over the drainage basin of the Mississippi River is led into the rivers and conducted back to the sea. It is evident that by far the larger portion of the precipitation that falls over the drainage basin is evaporated back from the land into the atmosphere, and is not returned to the sea through the medium of drainage. These figures show further that the source of precipitation of the Mississippi drainage area is from evaporation over the land and not derived from evaporation over the sea. Mr. Lindsay computed the discharge of the Mississippi River at Carrollton, Louisiana, and found that the average for fourteen years was 117 cubic miles per year, or 545,800 cubic feet per second, which is less than three times the precipitation over the state of Missouri.'

It seems to the writers that forests have something to do with the amount and distribution of the rainfall of the Ohio Valley. It is impossible to say, how much, until a long series of experiments over the entire drainage basin of the Ohio Valley are perfected. Owing to the rapid decrease in our forest areas these experiments should be carried out as soon as possible, for it takes many years to replace a forest once it is entirely removed.

Deforestation in the northern part of this State has had less to do with the increase of flood frequency and height than the great amount of ditching that has been done in the last forty years. The ditching has been of two kinds; first, large open ditches known as

dredges, and second, the tile drains that feed the former. The following is the amount of tile drains and dredge in three of the northern counties:

Fulton County. In Fulton County there are 75 miles of open dredge ditch and an equal number of miles of tile drains, twelve inches in diameter or larger. Feeding these dredge ditches and larger tile drains there are hundreds of miles of smaller tile drains. In fact, this county is underlain with a net-work of small tile drains that tend to hurry the rainfall to the larger streams. The immediate run-off is greatly increased thereby, the flood height is increased, and the duration of high water lessened.

Starke County. A letter from the surveyor of Starke County written to the writers will be given, as it explains the situation very well.

> Sir: We have about 190 miles of dredge ditch in this county, of which 135 miles have been completed within the last ten years. We have about 20 miles under construction and petitions are on file for 50 miles more and the Commissioners are acting on 5 miles more.
>
> There are between 45 and 50 miles of tile drains 10 inches or larger in the county. My opinion about the high water is as follows: the trouble lays in the poor outlet that we have for our lowland ditches. We have opened out marshes and lakes into the streams and never once give it another thought. When our marshes receive a heavy rain fall the good ditches rush the water to the rivers and cause floods, and will do so until we get a final outlet or close our ditches to hold the water.
>
> Yours respectfully,
>
> CHAS. A. GOOD.

St. Joseph County. In this county there are 110 miles of dredge ditch and more than 30 miles of tile drains, that are twelve inches in diameter or larger.

These three counties are a fair average of the northern part of the State. North of the Wabash River it is possible to control the floods in a large measure, if not altogether. It might be possible to put dams across the outlets of the numerous lakes. These dams should be equipped with flood gates that could be lowered in times of excessive rainfall, thus ponding the water until the crest of the flood has passed. Later the flood gates could be opened and the lakes lowered to their normal condition. Also a small amount of power could be made in this manner. Silt may be collected that otherwise would be carried to the Gulf. Better still, instead of letting the water out of the lakes after the streams have carried away the flood waters that could not be controlled, the

excess water might be kept stored or ponded and in times of drouth, which occur so often in Indiana, it might be applied to the fields, insuring a yield where applied.

It might be possible to close the tile drains and some of the smaller open ditches while there is an excess of rainfall, and, after the immediate run-off has escaped, these tile drains could be opened again. This would not hinder farming to a great extent and would give the water time to soak into the ground instead of being rushed off to the rivers. Some sediment might also be kept from being carried away. The amount of water that will soak into the soil or ground depends on the nature of the soil, the length of time that the water is exposed to the soil, and the temperature. That is, a light sandy loam or a muck soil will absorb surface water much faster than a fine impervious clayey soil. King, of Wisconsin, has shown that a clay soil will hold water much longer than the sandy soil.

The great number of various kinds of ditches in Northern Indiana carry the water away so rapidly that it does not have time to soak into the ground. This also tends to lower the water table, thereby making the distance that the water must travel by capillary attraction greater as it comes to the surface to feed the growing plants. Also the greatly reduced forest area permits the water to escape more rapidly, less water is absorbed into the ground, the immediate run-off is increased, and the flood stages are correspondingly heightened, while the low water stages are much lower. When the ground is frozen it is impossible to control the immediate run-off.

The imperfect records of the Kankakee River show that the flood stages are getting higher and that the low water stages are getting lower and of longer duration. Thirty years ago the ordinary low water discharge at the mouth of the Kankakee River was something near 1,300 cubic feet per second. As near as the writers are able to find out, the low water discharge at the present time is less than two-thirds what it was thirty years earlier.

The rainfall during the last thirty years has not perceptibly fallen off nor does it seem to be greater during the winter months now than formerly or less during the summer months than thirty years earlier. Thus it seems that deforestation, and increase in the number of dredge and tile ditches have caused the flood heights to be increased and the low water stages to become lower and of longer duration.

The writers are not so sure that there has been a *decided in-*

crease in flood frequency in the Ohio Valley during the last forty years. For instance, Professor Alfred J. Henry (Bulletin 'Z' of the United States Department of Agriculture Weather Bureau) has shown that by taking the severe floods of the last forty years, on the Ohio River, there were 19 severe floods during the first 20 years, and 32 during the last 20 years, ending 1910. Now if the last 30 years are divided into two equal periods and the first 15 years compared with the last 15 years the order of frequency is reversed. The following table taken from 'Bulletin Z' of the Weather Bureau Publications shows the above in tabular form:

TABLE No. 6.

Stations.	First period of 20 years, 1870–1890.	Second period of 20 years, 1891–1910.	First period of 15 years, 1881–1895.	Second period 1896–1910.
Pittsburg........	2	9	3	8
Cinceinnati......	6	7	8	5
Louisville........	5	5	7	3
Evansville.......	6	11	8	9
Totals.......	19	32	26	25

It is a fact that great floods are dependent upon excessive rainfall; also it is a fact that deforestation and the increase of artificial drainage have a tendency to rush these excessive waters to the main streams, causing the height of the flood to become greater in a shorter length cf time. Just how much that this will increase the height cannot be determined until more data are accumulated, showing the discharge of the streams and the amount of precipitation over large and various areas. Mr. Henry suggests that it will take at least 50 years to get together sufficient data to determine the effect.

The Lowering of the Water Table

It is beginning to be a well known fact that the water table over the entire State is being lowered. This is the case in several states scattered over the United States, as in Michigan, Alabama, Florida, California, Colorado, Nebraska, South Dakota and Wash-

ington. In these states laws have been enacted so as to prevent the unnecessary waste of the underground water. The following table will show to some extent the amount that the water table is being lowered in Indiana. This data was published in the Proceedings of the Indiana Academy of Science, for 1910, by Mr Charles Brossman.

TABLE No. 5.

CITY.	Total drop.	Years.	Feet per year.
Kentland	48	5	9 4-5
Elwood	40	12	3 1-3
Greensburg	40	10	4
Muncie	28	....	....
Remington	8	10	4-5
Marion	6	20	3-10
Butler	4	10	2-5
Linton	30	6	5
Kokomo	15	15	1

These towns are pretty well distributed over the State and are a fair representation of the State at large. The last column shows the average fall in feet per year. If this is a fair test, it will not be very long, possibly it may occur even in this generation, until the water table will be so lowered as to become a very serious matter.

Mr. F. G. Clapp, of the United States Geological Survey, believes that the decline of the water table is due to the following causes, named in the order of their importance:

1. Waste of Water.
2. Surface drainage by ditching for cultivation.
3. Over-development of the underground water.
4. Deforestation.

The people of the United States do not seem to realize that the natural resources of this new country are limited. Resources such as coal, oil, gas, timber and water,—especially the first four, are the result of many years labor on the part of Nature, and cannot be replaced when once exhausted.

Water, the most abundant of all our natural resources, is becoming a luxury, and it behooves the present generation to consider and start a movement for the conservation of it. In Madison

County there are at least 100 flowing wells which average twenty gallons per minute. This would make a total of about 1,700,000 gallons per day, or more than enough water for a city of 30,000 inhabitants without extensive manufacturing plants. These wells could be closed up when not in use. If this water was being used it would be permissible, but to let it be wasted is resulting in materially lowering the water table each year.

The loss of water is not the only offensive thing to be considered. Dr. J. W. Beede, of Indiana University, in a paper before the Indiana State Board of Health, has shown that old adjustments are broken as the water table is lowered, thus causing what once was good water to become unfit for use. The water that makes up the water table is not derived from an inexhaustible source, but in a large measure depends upon the immediate rainfall, and if this is carried away by an elaborate system of ditches, but little water will have a chance to soak into the ground to replenish the lowering water table. On the other hand the water is carried away at once and helps to increase the height of the flood stage. It seems that it is absolutely necessary to drain our cultivated fields, but in doing so there should be some way by which we could retain the surplus waters and thus permit some of them to return to the ground, raising the lowering water table, and, by decreasing the immediate run-off, lessen the flood height and intensity.

Another source of waste of water is the great amount of water that is so recklessly used in cities. Ordinarily in a city where there is not much manufacturing, 40 gallons per capita per day is sufficient for all ordinary needs. As a rule there are many times that amount pumped. The following cities all use more than is necessary:

Rochester	125 gallons per day per capita.
Goshen	150 gallons per day per capita.
Peru	100 gallons per day per capita.
Danville	150 gallons per day per capita.
Lebanon	100 gallons per day per capita.
Washington	125 gallons per day per capita.

These data were taken and compiled by Mr. Charles Brossman, of Indianapolis; they give a fair idea of the use of water by the towns and cities over the State; and if the statement made by Mr. Clapp, that for the ordinary city forty gallons per capita per day is sufficient, is true, they show that there is a great amount of water wasted every day that might as well be left in the ground. This loss or misuse of water could be remedied by the installation of a sufficient number of meters. Of the 144 towns and cities in

Indiana studied by Brossman, only fourteen had more than 300 meters, 13 between 100 and 300, 51 below 100 meters, and 66 were without meters at all. Thus less than ten per cent of the cities studied had sufficient meters to regulate the amount of water used. In Bloomington, where the municipal water supply is limited, there are very few meters.

The lowering of the water table at Chicago is due to over-development, and cannot be remedied. In 1864, the water in the flowing wells stood 111 feet above the level of Lake Michigan, but at the present time it is fifteen or twenty feet below the ground.

The fourth and last factor concerned in the lowering of the water table is deforestation. This factor has been dealt with to a certain extent earlier in the report but it is well to emphasize the results of deforestation by citing an illustration taken from the 'Eighteenth Annual Report of the United States Geological Survey,' Part Four:

'Queens creek of Arizona is a typical stream in a barren treeless water shed which has a rain fall of about fifteen inches per year. The area of this water shed is about 143 square miles and 61 per cent of it is above 3,000 feet. The maximum flood discharge in 1896, was 9,000 cubic feet per second. During a greater portion of the time the creek was dry. In this case there was very little chance for the water to soak into the ground. . . . .

'Cedar creek, in Washington, is typical of streams flowing from timbered water sheds. The basin of Cedar creek lies on the western slope of the Cascade mountains, and is covered with a dense forest and a very heavy undergrowth of ferns and mosses. The drainage is the same as that of Queens creek, 143 square miles. The precipitation for the year 1897, was 93 inches for the lower portion of the basin and probably 150 inches for the mountain summits; in spite of the fact that the precipitation in Cedar Creek basin was from six to nine times more than that in Queens creek basin, the maximum flood discharge of Cedar creek for 1897, was but 3,601 cubic feet per second, as against the 9,000 cubic feet for Queens creek. On the other hand the flow of Cedar creek was continuous through the year, and the minimum discharge was never less than 27 per cent of the mean for the year. The mean discharge of Cedar creek was 1,089 cubic feet, as against 15 cubic feet for Queens creek. This radical difference between the behavior of the two streams can be explained only by the difference in the soil covering of the two basins. Cedar creek basin is covered with a heavy forest, while Queens creek is almost entirely bare with a few scattered pinyon trees and a little brash or grass.

This illustration shows the intimate relation that exists between the process of deforestation and the control of our flood waters. It also shows an evident cause of the lowering of the water table in this and other states. This is a practical demonstration and should carry considerable weight in the determination of our attitude toward the question of flood control.

Control of Floods in China, Japan, and Korea

The following discussion is based upon F. H. King's 'Farmers of Forty Centuries.'

The people of China, Japan, and Korea are farming land that has been in service almost 4,000 years and there are only two acres per capita, half of which is unfarmable. The question of sufficient room for the masses of the people has been a serious proposition for over 4,000 years. Over 4,100 years ago, Emperor Yao appointed 'The Great Yu,' 'Superintendent of Works,' and entrusted him with the work of draining off the waters of the disastrous floods and of canalizing the rivers. He worked at this for thirteen years, after which he was called to be Emperor. This man saw the need of some definite line of procedure for the conservation of the vast amount of sediment that was yearly being lost by the great rivers, Howang Ho, Yangste Kiang, and the Canton. He realized that the flood waters should be shut off from the precious farm land. As a result this man started a system of canals to be filled with the flood waters, which form today a network of water ways, all over the delta region. A conservative estimate would place the number of miles of canals and leveed rivers in China, Japan and Korea at 200,000 in all. That is, forty canals across the United States from east to west, and sixty from north to south would not equal in number of miles those of the three countries today. King goes on to say that this estimate is possibly not too large for China alone.

These canals are about eight feet below the level of the surrounding fields and are about twenty feet in width. In times of high water these canals are permitted to fill up and when the water in the main stream goes down the water is drawn from the canals. While the water stands in the canals the sediment is deposited in the bottom and after the canals are drained this sediment is carried by hand and spread over the surrounding fields. This not only enriches the fields but builds them up a little higher each time, getting them a little farther from the danger of following floods. As much as an inch of this mud is spread over the fields at a time. This transfer of mud is done by human labor altogether.

To quote from King's, 'Farmers of Forty Centuries,' concerning other processes in conjunction with the canals: 'As adjuncts to these vast canalization works there have been enormous amounts of embankment, dike and levee construction. . . . Along the banks of the Yangtse, and for many miles along the Hoang Ho,

great levees have been built, sometimes in reinforcing series of two or three at different distances back from the channel where the stream bed is above the adjacent country, in order to prevent the widespread disaster and to limit the inundated areas in times of unusual floods. Again, in the Canton delta there are hundreds of miles of sea wall and dikes, so that the aggregate mileage of construction work in the Empire can only be measured in the thousands of miles. . . . In addition to the canal and levee construction works there are numerous impounding reservoirs which are brought into requisition to control overflow waters from the great streams. Some of these reservoirs, like the Tungting Lake in Hupeh and Poyang in Hunan, have areas of 2,000 and 1,800 square miles respectively and during the heaviest rainy seasons each may rise through twenty or thirty feet. Then there are other large and smaller lakes in the coastal plains giving an aggregate reservoir area exceeding 13,000 square miles. All of which are brought into service in controlling the flood waters, all of which are steadily being filled with the sediments brought from the far-away uncultivated mountain slopes, and which are ultimately destined to become rich alluvial plains, doubtless to be canalized in the manner that we have seen.'

King also shows how by the process of building up the low swamp land with sediment that is deposited in the reservoirs and in the canals that the land has been pushed out into the sea. By this process, the shore has been pushed seaward from 15 to 50 miles since the beginning of the Christian era.

He sums up the effect of these processes that we have been considering in the following words; 'Besides these actual extensions of the shore lines the centuries of flooding of the lakes and low lying lands has so filled many depressions as to convert large areas of swamp into cultivated fields. Not only this, but the spreading of the canal mud broadcast over the encircling fields has had two very important effects namely, raising the level of the low lying fields, giving them better drainage and so better physical conditions, and adding new plant food in the form of virgin soil of the richest type, thus contributing to the maintenance of soil fertility, high maintenance capacity and permanent agriculture through all the centuries.'

In the United States, along the same lines, now that we are considering the development of inland water ways, the subject should be surveyed broadly and much careful study may well be given to the works these old people have developed and found serviceable through so many centuries. The Mississippi River is

annually bearing to the sea nearly 225,000 acre feet of the most fertile sediment, and between levees along a raised river bed through two hundred miles of country subject to inundation. The time is here when there should be undertaken a systematic diversion of a large part of this fertile soil over the swamp areas, building them into well drained, fertile fields provided with water ways to serve for drainage, irrigation, fertilization and transportation. These great areas of swamp land may thus be converted into the most productive rice and sugar plantations to be found anywhere in the world, and the area made capable of maintaining many millions of people as long as the Mississippi endures, bearing its burden of fertile sediment.

This bears a close relation to the flood situation in Indiana, for any solution of the flood conditions here must begin at the mouth of the Mississippi River and then embrace each of the tributaries. It is almost useless to try to protect different places along a stream even as small as White River. Suppose that we make the whole of White River an ideal stream, one that will carry away all of the excess waters rapidly enough to keep the flood plain from being inundated: railroad grades, public road grades, and bridges to be so constructed that the water would be permitted free passage and not impounded in the least: the channel made large enough to carry an amount of water equal to that of the March flood. What would be the result of such an improvement? The result is easily comprehended: the water will be dumped into the Wabash River in such a short time as to cause it to assume flood conditions at once and the damage will be greater than before the improvement of White River. The region of flood damage would be shifted down stream to the Wabash, where the height of the flood would be greatly increased. The people of the White River Valley would have simply put their troubles and losses on the people below.

It seems impracticable to try to provide a channel large enough to carry the amount of water that came down White River last March. Improvements on the channel would help to take care of the ordinary flood. That is the phase that we wish to guard against first, and then try to cope with floods of the proportions of the recent one.

A Brief Consideration of Reservoirs

The effect of natural reservoirs upon the discharge of streams is shown in a striking manner in the Niagara River. The stream flow here is very constant, the maximum being only 35 per cent

greater than the minimum discharge. According to Van Hise, the maximum flow of the St. Lawrence River is only 50 per cent greater than the minimum flow. Considering the size of these rivers, that is a remarkable record. The Kankakee River, which is fed by numerous lakes and swamps, has a rather constant flow, but this equilibrium is being wrought out of adjustment by the draining of a large portion of the swamp land during the last few years. The effectiveness of reservoirs and lakes in making the flow or discharge of a stream constant cannot be overestimated.

Where the relief and geologic structure permit, artificial reservoirs may be constructed in such a way as to hold back a large percentage of the excess rainfall. Much of the unglaciated part of the State is of such a nature. The surplus may be used for irrigation and the production of power in small plants. The power that is developed may be used to lift a part of the water up to the level of the fields that are to be irrigated. The needs and benefits of irrigation in a humid region are being realized today.

Mr. W. W. Roebuck, of Ft. Wayne, Indiana, at the National Irrigation Congress at Chicago, December 5-9, 1911, said, 'I know of an irrigated farm of eighty acres, and there is not more than half of this farm, or there is less than half of this farm that has been cultivated annually, and the products have been over $15,000 annually. It is a demonstrated fact that we can grow more than double, take it one year for another, by irrigation.'

There is sufficient rainfall in Indiana. However, it does not always come at the time needed to produce maximum crops. Three weeks without a rain will often damage a crop fifty per cent, while water applied at the proper time would insure a maximum yield. If it were possible to hold back the surplus waters in times of excessive rainfall, in reservoirs, it could be made to serve a two-fold purpose: it would furnish water for irrigation and at the same time keep the flood stages lower.

In Monroe County there are several places where dams may be constructed where the water may be used either for municipal water supply or for irrigation. Bloomington may secure an ample supply of water by putting a dam across Griffy Creek, just above the North Pike bridge. The excess water of seven square miles may in this way be made useful instead of a menace to life and property, since it, as a contributing factor, causes White River to assume flood stages. Below this dam would be several hundred acres of land that could be made to produce in an unfailing manner. The lack of topographic maps makes it difficult to construct such

reservoirs economically. Properly planned, such reservoirs would pay for themselves by furnishing water for irrigation and at the same time help to reduce the flood stages, and keep the water table from getting any lower.

It is conceded that no system of reservoirs would have been ample to have prevented the recent flood, or even to have mitigated it perceptibly. The truth of this statement is clearly brought out when one considers the enormous amount of water which fell. The following figures will make this clear; they concern the White River basin alone. The water which fell would cover:

7,626	square miles of territory	1 foot deep.
763	square miles of territory	10 feet deep.
305	square miles of territory	25 feet deep.
152½	square miles of territory	50 feet deep.
76¼	square miles of territory	100 feet deep.

Or, from another point of view,—

4,860,640	acres	1 foot deep.
487,064	acres	10 feet deep.
194,826	acres	25 feet deep.
97,418	acres	50 feet deep.
48,706	acres	100 feet deep.

Or, from another point of view,—

10 acres to every square mile 44 feet deep.
20 acres to every square mile 22 feet deep.
40 acres to every square mile 11 feet deep.

Or, from another point of view,—

11 acres to every 160 acres 10 feet deep.
5½ acres to every 80 acres 10 feet deep.

Or, from still another point of view,—

1-15 of any area 10 feet deep.

These figures, based on U. S. Weather Bulletins, show that a system of reservoirs would have had to have been very elaborate indeed to have had any influence upon such a flood as the recent one. It seems to the writers that any reservoir system proposed for the White River region for the mitigation of damage due to floods alone, when the enormous cost is considered, is impracticable. As a side issue only, artificial reservoirs may be thought of in connection with floods in this region.

If we eliminate the reservoir idea, the question of protection

to our cities and towns is still before us. The writers are scarcely willing to venture any proposal, not having given this phase of floods more than passing notice. But it seems that the one practical thing for the present is to build strong levees sufficiently high to prevent the possibility of the waters getting over them into the towns and cities. A study of the situation will very likely prove this proposition not only practical, but a necessity, if any precautions are to be taken at all.

PART IV. SUMMARY OF FACTS AND CONCLUSIONS

1. Excessive rainfall was the only cause of the flood.

2. The excessive rainfall was due to two areas of high pressure, one over the Bermuda Islands and the other over Eastern Canada, remaining stationary from March 22nd to March 27th, holding back the two storms, causing them to spend their energy over the Ohio Valley for five days.

3. There was an average of 10.53 inches of rainfall at twenty weather bureau stations, in the White River drainage basin.

4. Only 2.43 inches of rain fell during the first twenty-two days of March.

5. An average of 8.28 inches of rain fell between March 22-28.

6. Within twenty-four hours 56.6 per cent. of the precipitation fell that caused the flood, or an average of 4.46 inches for the entire drainage basin.

7. Floods in the Ohio Valley are generally caused by heavy rainfall, melting of heavy snow, ice jams, failure of reservoirs, and the breaking of levees. The latter four factors generally act in conjunction with the excessive rainfall.

8. According to Leighton, floods in the Eastern part of the United States are increasing, and that the main cause for the increase is deforestation. However, in the White River valley, the writers think that the enormous increase of artificial drainage should be added to deforestation.

9. The water table of large parts of the State is being lowered by the increase of artificial drainage, deforestation, the waste of water by cities, and the general waste of water, as at abandoned oil wells.

10. Many lakes in the northern part of the State could be equipped with flood gates at their outlets, thus holding back much of the excess rainfall, permitting it to be carried away after the crest of the flood has passed. This would partly restore the water table. This would be practical for the upper Wabash region.

11. If meters were installed to regulate the amount of water used in cities the waste would be reduced almost one-half.

12. Mr. Charles Brossman has shown that only 10 per cent of the cities of Indiana have a sufficient number of meters to regulate the amount of water used.

13. A close study of Cedar Creek in the State of Washington, and Queens Creek in the State of Arizona, shows that deforestation

increases the immediate run-off, makes the flood stages higher, and the low water stages lower.

14. Deforestation causes an increase of soil erosion.

15. Natural reservoirs on large streams tend to make the flow constant.

16. Where relief and geologic structure permit, artificial reservoirs may be constructed, holding back part of the flood waters which may be used for municipal supply, power and local irrigation.

17. It is a demonstrated fact that irrigation in a humid climate will greatly increase the crops and guard against drouth.

18. Along much of its course White River flows two miles to get one. In many places a two-mile stretch of river could be reduced to less than a mile by making a cut-off.

19. In many cases a series of dynamite charges could be used to open up the new channel instead of the expensive method of dredging.

20. Shortening the course increases the fall, which will be distributed up and down the channel.

21. By doubling the velocity, the transporting power is increased sixty-four times.

22. As soon as the water spreads out over the banks it takes a more direct course, thus having its velocity increased. However, the friction is greater and tends to check the current.

23. A meander increases in size up to a certain stage and then the current which has been cutting on either side of the neck meets and a cut-off is perfected.

24. A cut-off generally throws the current to the opposite side of the stream, thus starting a new meander.

25. Stumps, trees, hay stacks, posts, and buildings on the flood plain may cause the current to cut holes.

26. Under the top soil which is from one to ten feet in depth is a layer of sand and gravel, which is easily moved by running water, causing the top soil to cave or fall in.

27. This gravel and sand shows that the stream has been shifting back and forth across the valley for a long time.

28. These beds of sand and gravel were formerly sand and gravel bars and in many cases show the structure.

29. Sand and gravel were deposited in areas up to 80 or 100 acres, and from a few inches up to ten feet in depth.

30. As a rule this sand was deposited upon good farming land.

31. Silt was deposited at the junction of the two forks in greater quantities than elsewhere. The next largest area of silt

deposition was at the mouth of the Muscatatuck, on the East Fork.

32. On the West Fork the loss from bank cutting must be as much as 100 acres per year and may be three or four times that amount, but not less.

33. There was at least 7,850 acres denuded, 160 acres lost by bank cutting, 1,520 acres badly covered with sand and gravel, and 15,600 acres covered with silt.

34. By using the statements of possibly a hundred farmers as to how much each of these different factors damaged the land, the estimate damage to soil alone was placed at $246,500. The total cost of replacing the structure damaged and destroyed is estimated at $498,998.

35. When the upper portion of the drainage basin has been deforested, the sediment that is derived from it and deposited on the flood plain is not so productive as it was before the removal of the forest.

36. China uses the sediment of her great rivers to build up the low ground near the delta region, thus reclaiming many hundreds of square miles for agriculture.

37. A great amount of the flood water is diverted by a system of canals into the low lying land where much sediment is deposited in the bottom of the canals and is later carried out upon the nearby fields, both enriching and building them up above the danger point of future floods.

38. Considerable bottom land of the lower Mississippi River could be reclaimed in this manner.

39. Railroad bridges are generally too small and restrict the flow of water.

40. The railroads that crossed the valley on trestle-work were not damaged.

41. Where a bridge or part of a railroad grade was washed out the railroad companies have not increased the length of trestle-work, but have rebuilt the grade.

42. Bank cutting is not limited to times of excessive floods, and can be prevented by the planting of trees, riprap, and jetties.

43. In the stretch of river studied the greatest loss was due to soil wash.

44. There has been no attempt to conserve the great amount of sediment that is being carried to the ocean.

45. The flood occurred at a time of year when there was a minimum amount of damage to the growing crops.

46. The flood of August, 1875, did more damage to the growing crops.

47. The flood of 1875 and the recent March flood were about the same in height.

48. The Mississippi River has been brought under control to a large extent by a system of levees.

49. No practical system of levees could have held White River within its banks.

50. At Romona, where the bluffs act as levees, the water was twenty to thirty feet in depth over the flood plain.

51. Groundhogs are the chief enemies of the levees on White River.

52. The valley is wide where it passes through the region of shales and is narrow in the limestone region.

53. Where the valley is wide the water spread out and killed much wheat. Where it is narrow, much damage was done by the erosive power of the currents.

54. As a rule, in the parts of the cities that were flooded there was less disease than at any corresponding time before. They cleaned up.

INDIANA UNIVERSITY STUDIES

23. ON NEW SPECIES OF FISHES FROM THE RIO META BASIN OF EASTERN COLOMBIA AND ON ALBINO OR BLIND FISHES FROM NEAR BOGOTÁ. By CARL H. EIGENMANN.

24. ON NEW SPECIES OF FISHES FROM COLOMBIA, ECUADOR, AND BRAZIL. By CARL H. EIGENMANN and ARTHUR HENN.

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INDIANA UNIVERSITY STUDIES

Nos. 23, 24, 25 BLOOMINGTON, INDIANA SEPTEMBER 5, 1914

Prefatory Note

The present papers form a continuation of Studies No. 16, 18, 19, and 20. They contain preliminary accounts of new facts chiefly concerning the freshwater fishes of northwestern South America. The collections on which the papers are based were made by the Landon-Fisher Expedition to trans-Andean Colombia, the Landon Ecuadorian Expedition, and the Indiana University Expedition to the Meta River of Cis-Andean Colombia.

Accepted for publication in the INDIANA UNIVERSITY STUDIES.

SAMUEL B. HARDING,
WILL D. HOWE,
ARTHUR L. FOLEY,
Committee.

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Editor's Note—Issued September 5, 1914.

(*Contributions from the Zoölogical Laboratory of Indiana University, No. 139.*)

23. On New Species of Fishes from the Rio Meta Basin of Eastern Colombia and on Albino or Blind Fishes from near Bogotá

By Carl H. Eigenmann

Copeina metae Eigenmann, sp. nov.

Copeina eigenmanni Regan, in part. Ann. Mag. Nat. Hist., (8), x, 393 (Bogotá).

13251a I. U. M. type, 35 mm.; 13251 I. U. M. paratypes, 34, largest 43 mm. Barrigona, Rio Meta, Colombia. Coll. and Manuel Gonzales, 1914.

Head 4; depth 5; D. 10; A. 10, rarely 11; lat. l. 22-24; eye about equal to interorbital, little greater than snout, a little less than 3 in the head; length of caudal peduncle equal to head from snout to upper angle of gill-opening; origin of dorsal nearer base of middle caudal rays than to head; a black spot on middle of anterior dorsal rays, sometimes extending to the tip of the rays; anal faintly margined with dark; a broad dark band from chin to caudal, faintly to the end of the middle caudal rays, most conspicuous and nearly as wide as the eye along the entire body, most intense just behind the head; a narrow light band above the dark band from the angle of the mouth to the base of the upper caudal lobe; back dusky. Markings of the sides in one specimen obscure.

Regan records presumably this species from Bogotá. His specimens were probably collected in the Meta, and some at least of those reported from Bogotá represent the present species.

Regan says of them: "In the smaller examples there is sometimes an indistinct dusky band on the anterior part of the body and an indication of a pale stripe above the dark one on the head. In the larger ones, from Bogotá, a silvery stripe from eye to caudal fin separates a broad dark band below from the dark colour of the back."

Otocinclus spectabilis Eigenmann, sp. nov.

13253a. I. U. M. type, 38 mm.; 13253 I. U. M. paratypes, 9, 29-38 mm. Quebrada Cramalote, Villavicencio. Coll. Manuel Gonzales, 1914.

Head to end of occipital about 2.5 in the length; depth 5.5; D. I, 7; A. I, 5.1; eye 3.5 in snout, 7 in head, 3 in interorbital; plates 22; ventral surface with a large anal plate, a wider, shorter, variously shaped plate in front of the anal plate, plates in front of this plate variable, sometimes a series of three plates extending entirely across the belly, sometimes two series, sometimes a series of three with an extra middle plate; a broad coracoid plate in

front of this irregular area. Temporal plate irregularly and imperfectly perforate; no adipose fin; origin of dorsal above middle of ventrals; plates without keels. Color of type: a dusky stripe forward from eye, joining a dusky stripe extending from snout to the nares; nares bounded by a dusky crescent behind; back faintly spotted, the spots forming obscure continuations of the prenasal stripe; first rays of pectoral, dorsal and anal and entire caudal obscurely barred.

Corydoras metae Eigenmann, sp. nov.

13451 I. U. M., Type 54 mm. Barrigona, Rio Meta, Colombia. Coll. Manuel Gonzales, 1914.

Head 3.25; depth 2.33; D. I, 8; A. I, 6; plates $\frac{23}{30}$; interorbital 2+ in the head; eye 4; snout nearly half length of head; suborbital about half length of eye; lower maxillary barbel just reaching gill-opening; dorsal spine equals length of head less opercle, base of dorsal a little greater than its distance from the adipose; pectoral spine very little shorter than head, extending beyond middle of ventrals; humeral shields widely separated below, not encroaching on the breast or belly; a dark band across nape, through eyes to lower edge of head; a black band across end of caudal peduncle continued forward along the middle of back and expanded on the dorsal to cover the entire fin except the distal .4 of the last seven rays. Otherwise without markings.

Albino or blind "capitanes" (Eremophilus mutisii Humboldt).

I have recently received three specimens of "capitanes" from the Rio Funjuelo at Usme Sur near Bogotá.

The largest measures a few millimeters over 160. It is not possible to give the exact number owing to the curves. This specimen is without pigment. The eye is apparent only on account of the lens and its overlying hyaline skin. The eye measures 2 mm. in diameter. This measurement is taken with the skin removed. The eye is not pigmented.

Another specimen measures 130 mm. It is also without pigment except in the eye. The eye seems to be fully pigmented and measures about 2 mm.

The third specimen measures 133 mm. The caudal and all but a small patch on the dorsal surface of the caudal peduncle are without pigment. The region from the caudal peduncle to the head is pigmented, but much more faintly than in normal specimens and there are irregular pigment-free spots. The sides of the head behind the eyes are free from pigment, the dorsal surface of the head and snout are again pigmented. The eye is normally pigmented and measures a little less than 2 mm.

These specimens seem to be in all respects except the color identical with the normal Capitan.

(*Contributions from the Zoölogical Laboratory of Indiana University, No. 140.*)

24. On New Species of Fishes from Colombia, Ecuador, and Brazil

By Carl H. Eigenmann and Arthur Henn

Rhoadsia minor Eigenmann and Henn, sp. nov.

Type 95 mm. I. U. M. 13419.

Paratypes, 3, 98-104 mm.; 88, 10-59 mm., I. U. M. 13420.

Mindo, Province of Pichincha, Ecuador. Rio Blanco of Rio Esmeraldas system, elevation 4,000 feet. Coll. Arthur Henn.

Head 3.8; depth 2.8-3; D. 11; A. 28-30; scales 9-15 + 25-8; eye 1.2-1.4 in snout, 3.8-4 in head and 1.3-1.6 in interorbital in mature specimens. Gill rakers 10 + 14.

Slender, compressed; profile oblique to end of occipital process, thence arched to dorsal. Predorsal area narrow, without a median series of scales, those of the two sides overlapping. Occipital process elongate, with five or six scales along its side.

Dorsal placed slightly in advance of middle of entire length, fourth and fifth rays longest, reaching to caudal base; adipose well developed; origin of anal under last rays of dorsal, 4th to 7th rays prolonged forming an anterior lobe; pectorals just to ventrals, the latter overlap considerably on the anal.

Scales regularly imbricate, lateral line developed on first 14 or 15 scales, caudal naked, one or two inconspicuous rows of small scales developed on about the first ten rays of the anal.

Teeth and maxillary greatly modified in development. Maxillary in young without teeth; on the premaxillary a series of five-pointed or six-pointed incisors, opposing identical incisors in the mandible. Maxillary in mature specimens elongate, slender, reaching below vertical from posterior margin of the orbit. Maxillary teeth in mature specimens consist of 13 conical spike-like incisors arranged along the anterior margin in addition to two tricuspid incisors near the premaxillary symphysis. Teeth of the premaxillary in two series, an outer series of one or two conical cusps in each premaxillary; these have no opponents in the mandible but simply project downwards and outwards from the snout. An inner series of five tricuspid incisors in each premaxillary interlocking with the incisors of the mandible. In each ramus of the mandible are ten teeth, the two innermost are conical and recurved, then three conical; the first is vertical, the outer two slant forward. At right angles because of the square mouth are five tricuspid incisors meeting their identical opponents in the premaxillary.

Exact field notes of color were not preserved. Coloration in life brilliant, the anal a combination of bright red and yellow, dorsal paler yellow, an oblong or deltoid spot of bright black in the mid-lateral line below the last rays of the dorsal. This is often produced as a straight line to the base of the caudal. Very young specimens possess a circular spot on the caudal base. This becomes obsolete with age and is lost when 40 mm. is attained. There is no indication of the lateral subdorsal spot below 28 mm. An obscure dark oval, humeral spot behind operculum followed by a vertical bar. Upper part of opercle silvery white, lower part deep black.

Closely related to *R. altipinna* Fowler of the Chimbo-Chan Chan basin of the Guayas system of Ecuador. *R. altipinna* is a much deeper and larger fish occurring probably not higher than the type-locality below Bucay, at an altitude of about seven or eight hundred feet. *R. minor* is a dwarf mountain form from over 4,000 feet.

R. minor is distinguished by its lesser depth, the relatively feeble dentition, more forward position of the dorsal and size. Scarcely any difference in number of scales. In mature specimens of Rhoadsia the maxillary extends to below the posterior margin of the eye. *R. minor* is mature when 95 mm. is attained and *R. altipinna* at 140 mm. A corresponding relation exists at all stages in the development of the maxillary. Among specimens of 40 mm. in *R. minor* the maxillary extends below the vertical from the anterior corner of the orbit. In *R. altipinna* the maxillary is more slender and extends but slightly beyond vertical from posterior nares. In specimens of 56 mm. *R. minor* has the maxillary reaching vertical from anterior third of eye; in *R. altipinna* the maxillary reaches vertical from anterior corner of orbit. At 95 mm. *R. minor* is mature; *R. altipinna* has the maxillary reaching nearly to the suture between the first and second suborbitals.

"From small, crystalline brooks of the Rio Blanco at Mindo at an elevation (Reiss and Stübel) of 4,136 feet. Mindo consists of the large hacienda San Vicente, situated in the extremely humid sub-tropical forests of the western folds of Mt. Pichincha, draining to the Rio Esmeraldas.

"A brillant little fish, locally known as 'doradillo' (little gilded one). I also heard of this little jewel, when in the hot dry valley of the Chota of Northern Ecuador, near the irrigated sugar plantation 'Cabuyal,' here at an elevation of some 4,900 feet."

Hemigrammus barrigonae Eigenmann and Henn, sp. nov.

Type, 41 mm., 13423 I. U. M.; paratypes 65 specimens 25-43 mm., 13424 I. U. M. Barrigona, Rio Meta. Coll. Manuel Gonzales.

Head 4; depth 2.6-3; depth of caudal peduncle 9-10; D. 11; A 24-25. Scales 33-35 in a longitudinal series, about 11 in a transverse series. Development of scales with lateral line pores *extremely* variable and not even equal on both sides of the same specimen. Usually a continuous series of at least 14 scales with pores, thence lateral line discontinuous; pore usually developed on last scale in the series. One specimen has the lateral line **16**+3+**1**+11+**2**, (the underlined numerals represent scales with pores). Another has **17**+6+**2**+4+**2**+3. A specimen of 41 mm. has the lateral line **17**+14+**2** on the left side and **16**+18+**1** on the right side. Of others, one, 34 mm. has respectively **24**+8+**3** and **20**+8+**7**; one, 37 mm. has **15**+19 and **16**+18; and one, 42 mm., has **24**+5+**5** on the left and **24**+7+**3** on the right side. The lateral line is developed on the seventh transverse series of scales. Scales in the type are 6-**16**+18+**1**-4. Eye 2.6 in head, about equal to or slightly greater than the interorbital.

Compressed, rather deep, caudal peduncle slender; predorsal area arched or rounded with a variable median dorsal series of scales, from 9 to 12 (usually 10); preventral area rounded, with an ill-defined median series of about 12 large scales. Occipital process about 5 in the distance from its base to the dorsal, bordered by three scales. Skull convex; fontanels moderately large; second suborbital in contact with the preopercle behind.

Mouth terminal; snout blunt, about one-half the eye; maxillary short,

about three-fourths the length of the eye. Premaxillary with three tricuspid in the outer row and five five- to six-pointed teeth in the inner row. Maxillary with four or five minute six-pointed teeth visible only in preparations. Mandible with four or five six-pointed incisors in each ramus, their tips flaring outwards. Caudal scaled over one-third of the basal lobe. Gill-rakers 7+6.

Origin of dorsal about equidistant from snout and base of middle caudal rays, its height 3.5 in the length. Origin of anal on vertical from last ray of dorsal, fourth to sixth rays elongate forming an anterior lobe, its height about 4.7-5 in the length, two large scales overlapping on the anterior margin. Caudal deeply forked, its lobes about equal to the height of the dorsal; pectorals do not reach the ventrals, the latter just overlap on the anal.

General coloration light olivaceous; operculum, cheeks and snout underlaid with bright silvery. Top of head dusky, no predorsal median line. A broad horizontal lateral stripe from the hind margin of the operculum to the caudal base, here expanded to form an ill-defined oval caudal spot. An indistinct humeral spot is overlaid by this lateral stripe. A conspicuous band of dark along the entire anal base, outer margin of anal sometimes tipped with this color. Fins, otherwise without color.

Hyphessobrycon metae Eigenmann and Henn, sp. nov.

Type, 34 mm. 13421 I. U. M.; paratypes, 66, 16-35 mm. 13422 I. U. M. Barrigona, Rio Meta. Coll., Manuel Gonzales.

Head 3.5-4, equal to depth at origin of dorsal; D. 11; A. 19-23, $\frac{19}{2}$, $\frac{20}{1}$, $\frac{21}{4}$, $\frac{22}{4}$, $\frac{23}{1}$, (the denominator represents the number of individuals); scales about 30 in a longitudinal series, 10 in transverse series; pores developed on 6 (rarely 7) scales; 9 or 10 scales between occipital and dorsal origin; scales 5-6+24-4; eye 2.3-2.6 in head, about equal to interorbital; caudal peduncle about equal to eye and 1.2 in its own depth.

Slender, compressed; predorsal area rounded with a median series of 9 or 10 scales, preventral area rounded with a median interpolated series of small (6) scales. Occipital process 6 in the distance from its base to the dorsal, bordered by 2 or 3 scales, interorbital slightly convex; fontanels very large. First and second suborbitals leaving a high naked margin behind and below. Mouth blunt, terminal; maxillary five-sixths the length of the eye. Premaxillary with three or four narrow tricuspid or broadly conical teeth in the outer row, five three to four-pointed teeth in a second series, an inner series of very small tricuspids or broadly conical teeth immediately behind them. Maxillary with two small tricuspids and one conical tooth, mandible with four strong three to five-pointed incisors in each ramus followed by about seven minute conical or recurved teeth on the sides. Gill rakers 6+5, short and strong.

Origin of dorsal about equidistant from snout and base of middle caudal rays, its height 3.2 to 3.5 in the length; adipose well developed; height of anal lobe 4 to 5 in length of fish. Caudal deeply forked, its lobes equal, about 4.5 in entire length. Anal origin slightly behind vertical from last dorsal ray; pectorals reach beyond ventrals; ventrals to beyond anal origin.

An obscure dusky, humeral spot, operculum underlaid with a dusky vertical semi-lunar area; top of head deep black produced into a line from occiput to dorsal. A narrow intense lateral stripe from upper margin of operculum to below last dorsal rays, broadening here to form a heavy broad black band on the caudal peduncle and an oblong caudal spot, the latter produced as a triangle

to the tips of the middle caudal rays. Scale margins above lateral stripe outlined with dusky, below heavily sprinkled with chromatophores. Bases of caudal lobes in life evidently tinged with deep red.

Bryconamericus novae Eigenmann and Henn, sp. nov.

Type, 56 mm., 3568a C. M.; paratypes 9, 30-57 mm.

3568b-j C. M. 3, 40-50 mm., 13308 I. U. M.

Below Cachoeira da Velha near Piabana, Rio Novo of Rio Tocantins, Lower Amazon basin, Coll., J. D. Haseman.

Allied to *B. hyphessus* differing in being less elongate, having the dorsal profile more arched and having an additional row of scales below the lateral line. Possibly identical with *B. diaphanus* (Cope).

Head 4; depth 3.2-3.6; D. 10; A. 18-20; scales 4-36-3; eye 2.4, a little greater than the interorbital.

Gill rakers 6+5, those of the upper limb minute.

Slender, compressed, dorsal and ventral profiles equally but only slightly arched; preventral area rounded without a regular median series of scales; postanal area rounded with 6 median scales; predorsal area with a median series of about 10 scales.

Occipital process short, about one-seventh of the distance from its base to the dorsal, bordered by two scales on the sides; interorbital flattened or slightly convex; frontal fontanel triangular, as wide as the parietal and two-thirds as long as the parietal without the occipital groove.

Snout blunt, lower jaw not extending beyond upper; maxillary slender, extending to suture between first and second suborbitals, its length four-fifths that of the eye; cheeks not very wide, covered by the expanded second suborbital, the anterior angle of which is overlapped by the first suborbital.

Maxillary with two or three minute tricuspid teeth in the inner angle near its symphysis with the premaxillary. Three to six conically tricuspid teeth in the first row or outer series of the premaxillary, the second or tooth next the symphysial tooth and the fourth are set back. These teeth are variable in number; there may be four on one ramus and five on the other or as in the type, six on the right ramus and three on the left. Inner series of premaxillary of four three or four-pointed teeth. Mandible with four large five-pointed teeth and a variable number of small tricuspids on the sides.

Scales cycloid, regularly imbricate, without interpolated or omitted scales; anal sheath of a single row of bifid scales on the base. Fourth lateral series or series above lateral line horizontal, of large scales, their vertical height about three-fourths that of eye. Lateral line decurved, parallel with the row of scales below it.

Dorsal origin about equidistant from tip of snout and base of middle caudal rays, height of its longest ray about 4.5 in the length; anal origin one scale behind vertical from last dorsal ray and equidistant from base of pectoral and base of caudal. Ventrals shorter than the pectorals, not reaching the anal. Pectorals barely reach ventrals, their length equal to the head minus the snout.

Straw colored, top of head darker but without a predorsal line; a broad postdorsal color band to caudal base. Cheeks and operculum bright silvery; a broad horizontal silvery lateral stripe just above the lateral line, terminating in a dusky caudal stripe or spot on caudal peduncle and base. A faint vertically elongate humeral spot under the third and fourth scales of the lateral line.

(Contributions from the Zoölogical Laboratory of Indiana University, No. 141.)

25. The Gymnotidae of Trans-Andean Colombia and Ecuador

By Carl H. Eigenmann and Homer G. Fisher

Ellis (Mem. Carnegie Mus., VI, 1913, pp. 109-195, plates XV-XXIII), gives a detailed account of the known distribution, synonomy, and bibliography of the Gymnotidae. It appears that four species of this family, *Gymnotus carapo* Linnaeus, *Sternopygus macrurus* (Bloch and Schneider), *Eigenmannia virescens* (Valenciennes), and *Hypopomus brevirostris* (Steindachner), have been recorded from the area under consideration and from Central America to the north of it. These four species are more widely distributed than any other Gymnotids. They are the only species found in the Rio San Francisco and they are all found in the Orinoco river or in Guiana, in the Amazon, in Uruguay or Southeastern Brazil, and in the La Plata basin.

Gymnotus carapo reaches the farthest north, being found in the rivers and lakes of both slopes of Guatamala. It has recently been recorded from the Rio San Juan of Trans-Andean Colombia by Regan (Ann. Mag. Nat. Hist. (8) XII, 1914, 466).

Sternopygus macrurus was recorded by Steindachner from the Magdalena (Fisch-f. Magdalenen Str., 1878, p. 53, pl. XIV, fig. 1) and from Guayaquil (Fisch-f. Cauca and Guayaquil, pp. 36 and 50, 1880). It has been taken several times since then at Guayaquil, and is recorded by Regan *l. c.* from the Rio Condoto of the San Juan basin.

Eigenmannia virescens was recorded by Steindachner (Fisch-f. Magdalenen Str., 1878, p. 55, pl. XIV) from the Magdalena, from the Mamoni at Chepo (Flussf.-Südam. I, 1879, p. 21), from the Cauca, (Fisch-f. Cauca and Guayaquil, 1880, p. 36), and Baranquilla on the Magdalena (Denk. Akad. Wiss. Wien, LXXII, 1902, p. 147).

Hypopomus brevirostris was recorded by Steindachner from the Cauca (Fisch-f. Cauca and Guayaquil 1880, p. 30).

Recently a fifth species, *Sternarchus rostratus*, has been recorded by Meek and Hildebrand (Field Museum Pub., 166, 1913, p. 85) from the Tuyra basin on the Pacific slope of Panama.

During the last two years large collections of Gymnotids were made by Eigenmann, January to April, 1912, in the Magdalena, Cauca, Dagua, San Juan and Atrato rivers; by Chas. Wilson, January to March, 1913, in upper San Juan basin and in the Atrato basin; by Arthur Henn, 1913, in the lower San Juan and its tributary the Calima and in the lowlands of western Ecuador; and by Henn and Wilson in the lower Patia basin. It is the purpose of the present paper to report on these collections.

1. **Sternarchus leptorhynchus** Ellis.

Of this species, hitherto known only from the Essequibo basin of British Guiana, one specimen 130 mm. (5593a C. M.) was taken by Henn in a small creek near the mouth of the Calima, and one specimen 209 mm. (13374 I. U. M.) was taken by Eigenmann at Cordova in the Dagua river. Both of these localities are on the Pacific slope of Colombia.

2. (?) **Sternarchus rostratus** Meek and Hildebrand.

Sternarchus spurrellii Regan, Ann. and Mag. Nat. Hist., (8), XIV, 1914, p. 32.

13376 I. U. M. 5595a-c C. M. 179-218 mm. Girardot. Coll. Eigenmann.

13377 I. U. M. 5596a C. M. two, 203 and 304 mm. Apulo. Coll. Gonzales.

13378 I. U. M. 5597a-d C. M. eight, 94-182 mm. Cartago. Coll. Eigenmann.

13379 I. U. M. 5598a-c C. M. five, 119-155 mm. Cauca at Cali. Coll. Eigenmann.

Head 5.3-6.5 in length to end of the anal; depth 1.1-1.3 in the length of the head; A. 151-175; snout 2.3-2.7 in the length of the head; eye 3-6.1 in the interorbital, 4-11.5 in the snout, 9-21 in the length of the head depending on the age; width of head 2-2.7 in the depth.

Evenly dotted or marbled, somewhat darker dorsally, a narrow, indistinct, light stripe along the median dorsal line from the end of the snout, disappearing on the posterior fourth of the body.

This species, if it is identical with Meek and Hildebrand's species, is found in the Magdalena basin of the Atlantic drainage and from the Tuyra basin of the Pacific slope.

3. **Sternarchus mariae**[1] Eigenmann and Fisher sp. nov.

5594 C. M. Type, 201 mm. Girardot. Coll. Eigenmann.

13375 I. U. M. Paratype, 273 mm. Apulo. Coll. Manuel Gonzales.

Head 7.1 type, (6.3 paratype) in the length to the end of the anal; depth .92 type, (.94 paratype) in the length of the head; anal rays 173 type, (176 paratype); snout 2.7 type, (2.5 paratype) in the length of the head; eye 5.5 type (5.7 paratype) in the interorbital, 5 type (6 paratype) in the head; width of head 2.4 type (2.5 paratype) in the depth.

Head decurved; gape reaching to vertical from the eye; ground color light buff, body closely pigmented with minute dark chromatophores, much more abundant dorsally. An uninterrupted whitish streak along the median dorsal line from the end of the snout to the base of the caudal.

4. **Hypopomus brevirostris** (Steindachner).

Hypopomus occidentalis Regan, Ann. and Mag. Nat. Hist., (8), XIV, 1914, p. 32.

13380 I. U. M. 5601a-e C. M. ten, 86-145 mm. Soplaviento. Coll. Eigenmann.

13381 I. U. M. 5599a-c C. M. six, 83-162 mm. Manigru. Coll. Wilson.

13382 I. U. M. 5600a-b C. M. five, 82-128 mm. Truando. Coll. Wilson.

13383 I. U. M. 5604a-b C. M. five, 50-168. Small creek near mouth of Rio Calima. Coll. Henn.

5602a-b C. M. two, 90 and 98 mm. Raspadura. Coll. Wilson.

5603a C. M. one, 91 mm. Quibdo. Coll. Wilson.

13384 I. U. M. 5605a C. M. three, 50-168 mm. Rio Calima near Boca del Guineo. Coll. Henn.

1. For Brother Apolinar Maria, director of the Natural History Museum of Bogota.

5. **Gymnotus carapo** Linnaeus.

13385 I. U. M. 5606a-b C. M. four, 142-306 mm. Small creek near mouth of Calima. Coll. Henn.

13386 I. U. M. 5607a-b C. M. four, 75-184 mm. Truando. Coll. Wilson.

6. **Sternopygus macrurus** (Bloch and Schneider).

5608a C. M. one, 191 mm. Cordova. Coll. Eigenmann.

5609a C. M. one, 111 mm. Cauca at Cali. Coll. Eigenmann.

13387 I. U. M. 5611a-c C. M. six, 59-306 mm. Small creek near mouth of Rio Calima. Coll. Henn.

13388 I. U. M. 5612a-c C. M. seven, 29-251 mm. Rio Calima near Boca del Guineo. Coll. Henn.

13389 I. U. M. 5610a-c C. M. eleven, 143-266 mm. Istmina. Coll. Eigenmann.

13390 I. U. M. 5613a-c C. M. six, 204-499 mm. San Juan at mouth of Rio Munguido. Coll. Henn.

13391 I. U. M. 5615a C. M. two, 443 and 471 mm. Calamar. Coll. Eigenmann.

13392 I. U. M. one, 288 mm. Rio Magui. Coll. Henn.

13393 I. U. M. two, 71 and 74 mm. Manigru. Coll. Wilson.

13394 I. U. M. 5614a-e C. M. 31, 282-700 mm. Guayaquil Market. Coll. Henn.

13395 I. U. M. one, 264 mm. Raspadura. Coll. Wilson.

13396 I. U. M. two, 234 and 251 mm. Rio Telembi. Coll. Henn and Wilson.

13397 I. U. M. 5614a-d C. M. eight, 188-453 mm. Soplaviento. Coll. Eigenmann.

13398 I. U. M. 5618a-c C. M. six, 121-399 mm. Cartago. Coll. Eigenmann.

5617a-b C. M. two, 271 and 311 mm. Apulo. Coll. Gonzales.

5619a C. M. one, 72 mm. Villavicencio. Coll. Gonzales.

5621a-b C. M. two, 484 and 531 mm. Puerto del Rio. Coll. Eigenmann.

This is the only species of the family found in Western Ecuador.

7. **Eigenmannia virescens** (Valenciennes).

13399 I. U. M. two, 242 and 414 mm. Barbacoas. Coll. Henn & Wilson.

13400 I. U. M. two, 219 and 385 mm. Rio Magui. Coll. Henn.

13401 I. U. M. one, 224 mm. Boca del Certegui. Coll. Wilson.

13402 I. U. M. one, 145 mm. Manigru. Coll. Wilson.

13403 I. U. M. 5620a-j C. M. 87, 76-270 mm. Calamar. Coll. Eigenmann.

13404 I. U. M. 5625a-g C. M. eleven, 102-289. Puerto del Rio. Coll. Gonzales.

13405 I. U. M. 5623a C. M. two, 207 and 236. Apulo. Coll. Gonzales.

13406 I. U. M. 5624a C. M. two, 185 and 222 mm. Girardot. Coll. Eigenmann.

13407 I. U. M. 5622a-o C. M. 136, 46-277 mm. Soplaviento. Coll. Eigenmann.

13408 I. U. M. two, 241 and 270 mm. Patia between Magui and Telembi Coll. Henn.

Vol. XII, No. 17 INDIANA UNIVERSITY BULLETIN February 15, 1915

INDIANA UNIVERSITY STUDIES

26. A STUDY OF THE PEOPLE OF INDIANA AND THEIR OCCUPATIONS FOR PURPOSES OF VOCATIONAL EDUCATION. By Robert J. Leonard, Professor of Industrial Education.

For Sale by the University Bookstore, Bloomington, Ind. Price 50 Cents

The 'University Studies' constitute a sub-series of the INDIANA UNIVERSITY BULLETIN, *in which from time to time are published some of the contributions to knowledge made by instructors and advanced students of the University. At present not more than three or four such numbers are issued a year. The 'Studies' are continuously paged and numbered, and, as needed, a title-page and table of contents will be issued for binding them in volumes.*

For sale by the University Bookstore, Bloomington, Ind.

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Contents

INDIANA UNIVERSITY STUDIES

No. 26 BLOOMINGTON, INDIANA FEBRUARY 15, 1915

Purpose and Scope

THE purpose of this study is, first, to establish a fact basis for the consideration of vocational education and the development of vocational schools and courses in Indiana; second, to serve as a reference and compendium of information concerning the people of the State and their occupations; and, third, to isolate specific problems requiring further study and investigation.

The facts herein recorded may be used as a basis for determining the general content of courses in elementary industrial art, pre-vocational courses in agriculture, industry, commerce, domestic and personal service, and vocational courses in "constant" occupational pursuits in the State. Since the occupational data concern the State as a whole, the facts are useful only in a general way for determining the specific day, part-time, and continuation vocational courses adapted to local communities.

As a compendium of information, it records the population facts of number, sex, age, residence in rural and urban communities, nativity, and illiteracy. It also records occupational facts showing actual and relative distribution of workers in the nine groups of occupations, the specific pursuits in each of the nine groups, together with the number of males and females so engaged, the number of boys and girls, youths, men, and women in each pursuit, and the number and percentage of skilled, unskilled, and semiskilled workers in the industrial occupations as well as the number of helpers and apprentices. Concerning manufacturing establishments, it records the number and distribution of factories in places of various sizes, an enumeration of the types of factories on the basis of the product, the number of males and females employed in each of the types of factories, the amount of wages paid workers, and the value of the manufactured products. The manufacturing enterprises in which Indiana ranks first, second, and third, compared with all States in the Union, are also specified.

The scope of the data is revealed by briefly stating the present status of the clothing industries in Indiana as recorded in the study. The clothing industries are grouped under the manufacturing and mechanical pursuits, which, compared with the numbers employed in the eight other group occupations, rank second, there being 310,402 males and females so engaged, or 29.9 per cent of the working population of the State. In the manufacturing and mechanical pursuits, the manufacture of clothing ranks third on the basis of total number employed, there being 3,565 males and 24,019 females. It is seen that over 80 per cent of the workers in this industry are females. The specific clothing pursuits in Indiana include dressmaking, employing 3 males and 13,469 females; sewing-machine operating, 165 males and 4,356 females; millinery, 96 males and 4,210 females; tailoring, 2,243 males and 756 females; suit and coat making, 315 males and 193 females; hat making, 134 males and 19 females; also 104 male and 149 female laborers, 504 male and 651 female semiskilled operatives, and 1 male and 216 female apprentices. Of all those engaged in the clothing industries in Indiana about 918 of each 1,000 workers were skilled, 64 semiskilled, and 9 unskilled, together with 8 apprentices.

Concerning clothing manufactured in establishments or factories it is noted that 4,073 workers were engaged in manufacturing men's clothing, including shirts, that their wages* amounted to $1,305, and that the value of the product* was $8,029; 1,933 were engaged in manufacturing hosiery and knit goods, receiving $687 in wages, the value of the product being $2,502; 1,582 were engaged in manufacturing cotton goods, receiving $478 in wages, the product being worth $2,502; 129 engaged in manufacturing women's clothing, receiving $449 in wages, the product being worth $2,058; 776 engaged in manufacturing woolen and worsted goods, receiving $293 in wages, the product being worth $1,570; 468 engaged in manufacturing boots and shoes, receiving $159 in wages, the product being worth $978; and 166 engaged in making millinery trimmings and lace, receiving $59 in wages, the product being worth $538. On the basis of the value of the manufactured products, the clothing industries ranked below the tenth.

Concerning the number of boys and girls under 16 engaged in the clothing industries, there were no boys reported as so engaged, but 589 girls were reported employed as follows: 99 dressmakers' apprentices, 8 dressmakers, 319 sewers and sewing-

*Expressed in thousands throughout this section.

machine operatives, 88 milliners, and 75 tailoresses. The specific clothing pursuits of women between the ages of 21 and 44 years and over 44 years are also recorded.

The two problems isolated for further study are, first, that of deriving and establishing a simple method by which local school authorities may ascertain the number and distribution of workers in the various occupational pursuits, and the age, sex, nativity, education, and educational deficiencies of these workers; second, that of detailed occupational analyses in terms of knowledge and skill required, etc., in these industrial pursuits: coal mining, marble and stone quarrying, slaughtering and meat packing; the chemical industries, manufacturing sewing-machines, automobiles, railroad cars and car parts, wagons, carriages, and agricultural implements.

The facts contained in the study were derived from the reports of the 1910 United State census, particularly from volumes one and two ("Population"), volume four ("Occupations"), and volume six ("Agriculture"), and volumes eight, nine, and ten ("Manufacturers"). Though the facts contained in these reports were derived in 1909 and 1910, it is thought that, in the main, they are relatively true for 1914, since changes in population, occupations, etc., have been in degree rather than in kind.

In this connection, however, several facts should be suggested. In 1913 the section of the Indiana school law concerning compulsory education was modified so that now working permits may be issued only to youths over 14 years of age who have completed the fifth grade, and all youths between the ages of 14 and 16 must be either attending school or profitably employed. This change in the law may have reduced the total number and percentage of boys and girls under 16 years of age profitably employed. Also, in all probability at the present time the number and percentage of residents in urban communities has increased so that now the population of Indiana is evenly distributed between the cities and the country. The number and percentage of workers engaged in industrial pursuits has also probably increased since 1910. The number and percentage of women in industry, trade, transportation, and public service has also probably increased. The manufacturing of automobiles and parts has also assumed a degree of greater importance since 1910.

In scope, the occupational information pertains to the State as a whole and State distributions, percentages, averages, etc., must not be applied alike to cities, towns, villages, and rural districts.

Thus, while for the State as a whole about 270 of every 1,000 females between the ages of 16 and 20 were profitably employed in wage-earning pursuits, this number and distribution are incorrect for both the cities and the rural districts, since in Indianapolis about 530 of every 1,000 females between 16 and 20 were profitably employed, whereas in country towns the number was much lower.

It is thought by the writer that the number of apprentices and helpers, as distinguished from laborers and semiskilled operatives, was not correctly measured by the census enumerations, and also that the distribution of industrial workers into skilled, semiskilled, and unskilled groups may be questioned, since there are as yet no clearly defined standards for this differentiation.

For those not wishing to read the entire bulletin, the material is so arranged that the condensed facts may be ascertained by reading the "Abstract and Summary" and "Deductions Relative to Education."

Abstract and Summary

CHAP. I. FACTS CONCERNING THE PEOPLE OF INDIANA

§1. **Population and State Rank.** The population of Indiana in 1910 was 2,700,816, and the State rank was ninth.

§2. **Interstate Migration.** Indiana has lost in population through interstate migration.

Up to 1910, there were living of those born in Indiana, 2,805,517, but of this number only 2,031,345 were residing in Indiana. This loss amounts to 774,171 persons. However, natives of other States to the number of 501,420 moved to Indiana, reducing the net loss to 272,751, or 7.8 per cent.

§3. **Distribution of Residents in Rural and Urban Communities.** During the last thirty years the rural population has decreased and urban population has increased so that in 1910, 57.6 per cent of the people lived in the country and 42.4 per cent lived in places of over 2,500 inhabitants.

Indiana, while gaining substantially in population from 1889 to 1910, lost in rank from sixth to ninth place, and the rate of increase during the same period lowered from 18.1 per cent to 7.3 per cent. From 1890 to 1910 the percentage of rural population decreased from 73.1 per cent to 57.6 per cent, and the urban population increased from 26.9 per cent to 42.4 per cent. The absolute number of residents in rural places was 5.1 per cent less in 1900 than in 1910, while, during the same period, the absolute gain in urban places was 30.5 per cent. In 1914 the number of residents in Indiana was doubtless evenly divided between rural and urban communities.

The greatest increase in population from 1890 to 1910 occurred in places from 10,000 to 25,000 inhabitants, and in places of this size 12.6

per cent of the people resided in 1910, a percentage greater than in other classes of places save the rural.

From 1900 to 1910 the number of places having a population or 10,000 to 25,000 increased from fourteen to twenty; those having from 5,000 to 10,000, from twenty-three to twenty-six, and those having 2.500 to 5,000 decreased from thirty-eight to thirty-seven. Aside from rural communities, the class of places where the greatest percentage of people resided was the 10,000 to 25,000, the percentage being 12.6 per cent, a gain of 3.9 per cent over 1900, and 6.0 per cent over 1890.

§4. **Colored and White Residents.** Considering the State as a whole, colored residents constitute but 2.2 per cent of the entire population.

In 1910 over 97 of every 100 inhabitants were native white born, and only two of every 100 were native colored born. Though from 1890 to 1900 the colored population increased 27.2 per cent as compared with an increase of 14.5 per cent of whites, from 1900 to 1910 the colored increase was only 4.9 per cent and the white increase 7.4 per cent.

§5. **Native and Foreign Born Residents.** Considering the State as a whole, but 5.9 per cent of the inhabitants in 1910 were foreign born.

In 1890, 93.3 per cent of the residents in Indiana were native born, and in 1910 the percentage was 94.1, leaving 5.9 per cent foreign born in 1910 as compared with 6.7 per cent in 1890.

Of the 159,322 foreign born whites in Indiana in 1910, 111,396 lived in urban communities and 47,926 in rural communities.

There are a sufficient number in the following places to constitute a real educational problem:

Indianapolis	19,767	Terre Haute	3,796
South Bend	13,420	Lafayette	2,019
East Chicago	10,295	Laporte	1,954
Gary	8,242	Mishawaka	1,803
Fort Wayne	7,204	Elkhart	1,636
Hammond	5,553	Logansport	1,405
Michigan City	4,528	Richmond	1,173
Evansville	4,462	Anderson	977

Foreigners are now coming to Indiana in greater numbers from Hungary, Austria, Russia, and Italy than formerly.

In 1890, 88 per cent of all foreigners in Indiana were from Germany, Ireland, England, Canada, Sweden, and Scotland; in 1900 this percentage had decreased to 83, and in 1910 to 63. On the other hand, in 1890 only 1 per cent were from Hungary, Austria, Russia, or Italy, while in 1900 the percentage had increased to about 6 and in 1910 to 27.

§6. **Illiteracy.** Illiteracy in Indiana has been reduced from 4.6 per cent in 1900 to 3.2 in 1910. More illiterates reside in rural than urban communities.

Of the total number of illiterates in 1910, 28,458 lived in cities and 37,728 in the country.

In the following cities more than 500 illiterates resided in 1910:

Indianapolis	5,874	Michigan City	908
East Chicago	3,017	Terre Haute	808
Evansville	1,938	Hammond	720
Gary	1,390	Whiting	605
South Bend	1,405	New Albany	550
Fort Wayne	1,152		

In the following counties more than 500 illiterates resided in 1910:

Allen	1,766	Lawrence	1,106
Bartholomew	796	Madison	1,356
Cass	644	Marion	6,563
Clark	911	Miami	520
Clay	1,012	Monroe	888
Crawford	658	Morgan	546
Daviess	637	Orange	566
Delaware	988	Parke	637
Elkhart	697	Perry	733
Floyd	730	Pike	873
Gibson	981	Posey	833
Grant	1,274	Randolph	561
Greene	1,247	St. Joseph	2,157
Harrison	619	Shelby	545
Henry	509	Spencer	749
Howard	581	Sullivan	966
Jackson	761	Tippecanoe	786
Jefferson	537	Vanderburgh	2,103
Knox	1,086	Vigo	1,814
Kosciusko	504	Warrick	775
Lake	6,065	Wayne	737
Laporte	1,606		

CHAP. II. THE OCCUPATIONS OF THE PEOPLE OF INDIANA

§1. **Methods of Determining Importance of Occupations.** In evaluating the importance of the various occupational pursuits in Indiana these factors were considered: The number of people engaged in the occupation, the monetary value of the product, the value added to the raw material by the process of manufacturing, the capital invested, the amount of wages paid, and the social worth of the pursuit of the occupation to the community.

§2. **The Distribution of Workers in the Nine Groups of Occupations.** On the basis of 1,000 workers, males and females were distributed in groups of occupations in 1910 as follows:

MALES.		FEMALES.	
PURSUITS.	Number of Workers.	PURSUITS.	Number of Workers.
ALL PURSUITS	1,000	ALL PURSUITS	1,000
Agriculture	381	Domestic and personal service	360
Manufacturing	308	Manufacturing	251
Trade	99	Professional service	128
Transportation	82	Clerical pursuits	96
Professional service	33	Trade	81
Domestic and personal service	32	Agriculture	57
Mining	28	Transportation	25
Clerical pursuits	27	Public service	2
Public service	10		

§3. **Occupational Pusuits of Various Age Groups.**

Of each 1,000 males of the various age groups there were 79 at work between 10 and 13 years; 377 between 14 and 15 years; 771 between 16 and 20 years; 969 between 21 and 44 years, and 829 workers who were 45 years and over.

Of each 1,000 males of the various age groups, there were engaged in each of the groups of occupations the number of workers indicated in the following table:

PURSUITS.	AGE GROUPS—MALES.				
	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.
At work, all pursuits	79	377	771	969	829
Agriculture	805	561	425	325	439
Manufacturing	36	171	253	286	242
Trade	114	77	74	95	103
Transportation	....	14	56	91	61
Clerical	19	44	44	30	13
Mining	....	28	31	32	18
Domestic and personal service	15	16	20	32	28
Professional	19	1	10	33	30
Public service	....	....	1	7	17

Of each 1,000 females of the various age groups there were 8 at work between 10 and 13 years; 103 between 14 and 15 years; 270 between 16 and 20 years; 175 between 21 and 44 years; and 104 who were 45 years and over.

Of each 1,000 females of the various age groups there were engaged in each of the groups of occupations the number of workers indicated in the following table:

PURSUITS.	AGE GROUPS—FEMALES.				
	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.
At work, all pursuits	8	103	270	175	104
Domestic and personal service	573	372	340	327	459
Manufacturing and mechanical	59	271	204	197	189
Clerical	9	56	123	115	16
Trade	15	61	81	19	44
Professional	12	10	81	167	60
Transportation	12	26	45	88	2
Agriculture	274	49	19	26	168
Public service	....	4	....	1	1

CHAP. III. AGRICULTURAL PURSUITS

Part I. General Status of Agriculture

§1. **Number of Agricultural Workers.** In 1880 over one-half of all workers in Indiana were farmers, but in 1910 less than one-third of all workers were so engaged.

In 1880, 522 of every 1,000 workers, or over one-half, were farmers. As a result of the increased numbers in other occupations, in 1890 only 460 were farmers; in 1900, 392, and in 1910, 322, or less than one-third of all workers.

In 1910, 381 of each 1,000 male workers and 57 of each 1,000 female workers in Indiana were engaged in the agricultural pursuits.

§2. **Number of Farms and Extent of Farm Acreage.** There were 6,412 fewer farms in Indiana in 1910 than in 1900.

In 1900 there were 221,897 farms in Indiana, while in 1910 there were but 215,485, making a net loss during the decade of 6,412 farms, or 2.9 per cent.

There were 519,800 fewer acres of farm land in Indiana in 1910 than in 1900.

In 1900 there were 21,619,623 acres of farm land, while in 1910 there were 21,299,823, a net loss of 519,800 acres, or 1.5 per cent.

§3. **Value of Farm Property.** From 1900 to 1910 the value of farm property increased 84.9 per cent.

In 1900 the value of all farm property, including land, buildings, machinery, live stock, etc., was estimated at $978,616,471. In 1910 the value of farm property was $1,809,135,238, or an increase of $831,518,767, or 84.9 per cent. This increase was probably due not only to actual improvements and additions to buildings, equipment, etc., but the normal increase in land values.

§4. **Value of Farm Products.** The value of farm products increased over 60 per cent from 1899 to 1909.

In 1899 farm products, including all crops, live stock, dairy products, whether sold or consumed, were valued at $204,450,196, while the farm products of 1909 were valued at $339,849,366, a net gain of $135,399,170, or over 60 per cent.

§5. **Character and Tenure of Farm Ownership.** The number of rented farms is increasing.

In 1890, 746 of every 1,000 farms were operated by owners and 254 by tenants; in 1900, 714 by owners and 286 by tenants; in 1910, 700 by owners and 300 by tenants.

Part II. Agricultural Pursuits in Indiana

§§1, 2. **Summarized Agricultural Pursuits; Number of Workers in Specific Agricultural Pursuits.** Nearly all agricultural workers in Indiana in 1910 were farmers and farm laborers.

Of every 1,000 agricultural workers, there were 963 farmers and farm laborers, 15 gardeners and greenhouse employees, 4 engaged in dairying, 3 fruit growers and nurserymen.

Of all farmers and farm laborers over one-half were farmers.

Of each 1,000 farmers and farm laborers, there were: 600 farmers, 241 farm laborers working out, 154 farm laborers working on home farms, 4 farm foremen.

§3. **Specific Agricultural Pursuits of Each Age Group.** Nearly all male agricultural workers under 20 years of age were farm laborers.

Of each 1,000 male agricultural workers 20 years and under there were:

	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.
Home farm laborers	807	697	484
Farm laborers working out	182	294	448

Chap. IV. Manufacturing and Mechanical Pursuits

Part I. Occupational Distribution of Industrial Workers

§1. **Number Employed in Industrial Occupations and General Status of Industrial Pursuits.** In 1880 about one-sixth of all workers were engaged in industrial pursuits, but in 1910 about one-third were so engaged.

In 1880 only 172 of each 1,000 workers were employed in the industries, but in 1890 the number increased to 205; in 1900 to 299; in 1910 to 322.*

Of each 1,000 male workers in 1910, 308† were employed in the industries, and of each 1,000 female workers, 251.

§2. **Workers in Summarized Industrial Pursuits.** Of each 1,000 male industrial workers there were engaged in each of the following pursuits:

Building trades	295	Printing and publishing	15
Metal industries	274	Clothing industries	13
Wood industry	78	Painters, glaziers and varnishers	12
Miscellaneous pursuits	69	Textile industries	6
Clay, glass, and stone industries	65	Cigars and tobacco	5
Officials	53	Chemical industries	5
Mechanical and electrical engineers	41	Liquor and beverages	5
Food and confectionery	28	Light, heat, and fuel	5
Leather and rubber	16	Paper and pulp mills	5

Of each 1,000 female industrial workers there were engaged in each of the following pursuits:

Clothing industries	614	Wood industries	27
Textile industries	82	Clay, glass and stone industries	18
Miscellaneous pursuits	69	Building trades	12
Cigar and tobacco industries	36	Officials	12
Printing and publishing	31	Leather and rubber industry	12
Metal industries	29	Chemical industries	12
Food and confectionery	27	Paper and pulp mills	4

§3. **Workers in Specified Industrial Pursuits.** In each of the manufacturing and mechanical pursuits in Indiana in 1910, there were of each 1,000 workers the following number of skilled, semiskilled, apprenticed, and unskilled employees:

	Skilled.	*Semi-skilled.*	*Appren-tices.*	*Un-skilled.*
Building trades	608	...	27	363
Metal industries	513	174	...	305
Clothing	918	64	8	9
Wood industries	217	399	...	379
Miscellaneous	306	255	105	334
Clay, glass and stone	167	317	...	508
Engineers (mechanical and electrical)	1,000	...		
Food and confectionery	446	207	...	347
Printing and publishing	738	219	...	40
Leather and rubber	321	483	...	192

*Including mining so as to make data comparable with previous decades.
†Does not include mining.

	Skilled.	Semi-skilled.	Apprentices.	Unskilled
Textile industries	3	834	...	158
Painters, glaziers and varnishers	1,000			
Cigar and tobacco workers	...	940	...	6
Chemical industries	...	421	...	476
Liquor and beverages	...	124	...	876
Light, heat and fuel	...	...	...	996
Paper and pulp mills	...	368	...	632

Of each 1,000 workers engaged in manufacturing and mechanical pursuits in Indiana in 1910, there were approximately: 371 skilled, 285 semiskilled, 8 apprentices, 334 unskilled.*

On the basis of 1,000 in each of the manufacturing and mechanical pursuits, workers were distributed in specific skilled, semiskilled, apprentices and unskilled occupations as follows:

BUILDING TRADES

Skilled		Semiskilled		Apprentices		Unskilled	
Carpenters	309			Helpers	22	General laborers	363
Painters, glaziers and varnishers	101			Apprentices	5		
Building contractors	72						
Brick and stone masons	48						
Plumbers, gas fitters	36						
Plasterers	24						
Paper hangers	18						
Total	608			Total	27	Total	363

METAL INDUSTRIES

Machinists and millwrights	229	Steel workers and rolling mills	70			Blast furnaces	127
Blacksmiths	113	Blast furnaces	38			Steel works and rolling mills	97
Iron molders and casters	68	Car and railroad shops	33			Car and railroad shops	48
Tinsmiths	27	Auto factories	23			Auto factories	23
Boiler makers	21	Miscellaneous	10			Miscellaneous	10
Rollers	15						
Miscellaneous	40						
Total	513	Total	174			Total	305

CLOTHING INDUSTRIES

Dressmakers and seamstresses	490	Clothing factories	41	Dressmakers and milliners	8	Laborers	9
Sewers and sewing machine operatives	164	Suit and coat factories	18				
Tailors and tailoresses	108	Hat factories	5				
Milliners and millinery dealers	156						
Total	918	Total	64	Total	8	Total	9

*Workers are here enumerated as skilled, semiskilled, and unskilled on the basis of the census classification.

WOOD INDUSTRIES

Skilled		Semiskilled		Apprentices		Unskilled	
Cabinet makers	96	Furniture, piano and organ factories	188			Saw and planing mills	120
Sawyers	68	Wagon and carriage factories	108			Furniture and piano factories	101
Coopers	32	Miscellaneous pursuits	64			Wagon and carriage factories	90
Wood carvers	11	Saw and planing mill operators	35			Miscellaneous pursuits	68
Wheelwrights	10						
Total	217	Total	395			Total	379

MISCELLANEOUS PURSUITS

Skilled		Semiskilled		Apprentices		Unskilled	
Firemen (except locomotive and fire departments.)	153	Miscellaneous factories	195	Miscellaneous factories	105	Laborers-Miscellaneous factories	318
Mechanics	45	Electrical supply factories	47			Laborers-Electrical supply factories	16
Pattern and model makers	34	Paper and box factories	13				
Upholsterers	28						
Machinery oilers	10						
Piano and organ tuners	9						
Miscellaneous	72						
Total	306	Total	255	Total	105	Total	334

CLAY, GLASS AND STONE INDUSTRIES

Skilled		Semiskilled		Apprentices		Unskilled	
Glass blowers	126	Glass factories	188			Laborers— Glass factories	192
Stone cutters	41	Brick and terra cotta factories	50			Brick, tile and cement	170
		Potteries	33			Lime, cement and gypsum factories	107
		Marble and stone yards	28			Marble and stone yards	26
		Lime, cement and factories	18			Potteries	13
Total	167	Total	317			Total	508

ENGINEERS

Skilled		Semiskilled		Apprentices		Unskilled	
Stationary engineers	658						
Electricians and electrical engineers	319						
Mechanical engineers	23						
Total	1,000						

FOOD AND CONFECTIONERY

Skilled		Semiskilled		Apprentices		Unskilled	
Bakers	273	Candy factories	69			Laborers— Slaughtering and meat packing	173
Millers (grain, flour and feed)	124	Slaughtering and meat packing	44			Flour and grain mills	53
Butchers and dressers (slaughter houses)	49	Fruit and vegetable canners	29			Miscellaneous	43
		Bakeries	26			Fruit and vegetable canners	37
		Butter and cheese factories	22			Bakeries	21
		Flour and grist mills	17			Butter and cheese factories	20
Total	446	Total	207			Total	347

PRINTING AND PUBLISHING

Skilled	Semiskilled	Apprentices	Unskilled
Compositors, linotypers, typesetters 589	Semiskilled 219		
Pressmen 91	Unskilled 40		
Engravers 29			
Lithographers 15			
Electrotypers 14			
Total 738	Total 259		

LEATHER AND RUBBER

Skilled	Semiskilled	Apprentices	Unskilled
Shoemakers and cobblers (not in factory) 321	Rubber factories 194		Laborers—
	Harness and saddle 175		Rubber factories 150
	Shoe factories 80		Tanneries 30
	Tanneries 34		Shoe factories 12
Total 321	Total 483		Total 192

TEXTILE INDUSTRIES

Skilled	Semiskilled	Apprentices	Unskilled
Loom fixers 3	Miscellaneous 376		Laborers—
	Weavers 320		Textile mills (other than cotton and woolen) 63
	Spinners 68		Woolen mills 59
	Winders, wheelers and spoolers 36		Cotton mills 36
	Carders, combers and lappers 20		
	Bobbin boys, doffers and carriers 11		
	Drawers, rovers and twisters 3		
Total 3	Total 834		Total 158

PAINTERS, GLAZIERS AND VARNISHERS

Skilled	Semiskilled	Apprentices	Unskilled
Painters, glaziers and varnishers. 1000			

CIGAR AND TOBACCO INDUSTRIES

Skilled	Semiskilled	Apprentices	Unskilled
	Cigar and tobacco 940		Cigar and tobacco 60

CHEMICAL INDUSTRIES

Skilled	Semiskilled	Apprentices	Unskilled
	Miscellaneous chemical factories 326		Miscellaneous chemical factories 452
	Powder and cartridge 70		Powder and cartridge 56
	Paint factories 25		Fertilizer factories 41
			Paint factories 27
	Total 421		Total 476

LIQUOR AND BEVERAGES

Skilled	Semiskilled	Apprentices	Unskilled
	Miscellaneous 77		Laborers 471
	Distillers 47		Laborers, breweries 405
	Total 124		Total 876

LIGHT, HEAT AND FUEL

SKILLED	SEMISKILLED	APPRENTICES	UNSKILLED
			Laborers— Oil refineries........ 345 Gas works........ 325 Light power plants... 302 Charcoal and coke works........... 26 Total............ 998

PAPER AND PULP MILLS

	Paper mills....... 368 Total.......... 368		Paper mills........... 632 Total............ 632

§4. **Specific Industrial Pursuits of Boys and Girls Under 16.**

The actual number of boys and girls under 16 in the industrial pursuits was as follows:

	Boys under 16		Girls under 16
Building trades	661	(613 laborers)	
Metal	414		41
Wood	642		84
Clothing	...		589
Miscellaneous	911	(830 apprentices)	224
Clay, glass, and stone	711		51
Engineers	6		
Food and confectionery	25		56
Printing and publishing	42		49
Leather and rubber	125		
Painters, glaziers, and varnishers	33		
Cigar and tobacco	16		222
Light and fuel	4		
Liquor and beverages	61		
Paper and pulp mills	34		
Textile	...		250

Part II. Specific Facts Concerning Manufacturing Establishments

§1. **Number of Establishments, Amount of Wages, and Value of Products.** The number of manufacturing establishments increased 841 from 1899 to 1909.

In 1899 there were 7,128 manufacturing establishments in Indiana, while in 1909 there were 7,969, a net increase of 841, or over 11 per cent.

The value of manufactured products increased over 71 per cent from 1899 to 1909.

In 1899 the value of manufactured products, expressed in thousands, was $337,072, while in 1909 it was $579,075, an increase of $242,003, or 71.8 per cent.

§2. **Localization of Manufacturing Establishment.** In 1910, 62.7 per cent of all manufacturing establishments were located in places of less than 10,000 inhabitants.

Of the 7,969 manufacturing establishments in Indiana in 1910, 2,975, or 37 per cent, were located in places of over 10,000 inhabitants, and 4.994, or 62.7 per cent, in places of less than 10,000 inhabitants.

In 1910, 60.3 per cent of all employees in manufacturing establishments were working in factories located in places of over 10,000 inhabitants.

Of the 186,984 workers in factories in 1910, 112,658, or 60.3 per cent, were employed in factories located in places of over 10,000 inhabitants, while 74,326, or 39.7 per cent, were in places of more than 10,000 inhabitants.

In 1910 the value of the products of factories in places of 10,000 inhabitants and over was 60.2 per cent of the total value of all products.

Of the total value of manufactured products, $579,075,046, we find that $348,759,733, or 60.2 per cent, was from factories in places over 10,000 inhabitants, while $230,315,313, or 39.8 per cent, was from places of less than 10,000 inhabitants.

§3. **Number of Boys and Girls and Men and Women Employed in Manufacturing Establishments.** Of those employed in manufacturing establishments in 1910, 19 of every 1,000 were under 16 years of age.

Of each 1,000 employed in manufacturing establishments in 1910, 862 were males over 16 years old and 119 females over 16 years old.

§§4, 5. **Number Employed in Manufacturing Establishments, Wages Paid, and Value of Products. The Principal Manufacturing Interests in Indiana.** The ten leading manufacturing pursuits and enterprises of Indiana from the standpoint of the number employed in 1910 were:

Foundry and machine shops; car manufacturing and repairing; iron and steel works and rolling-mills; furniture and refrigerator; lumber and timber products; glass; carriage and wagons; automobiles, including parts and bodies; printing and publishing; agricultural implements.

The ten leading manufacturing pursuits and enterprises from the standpoint of the value of the products in 1910 were: Slaughtering and meat-packing; flour and grist-mills; foundry and machine shops products; iron and steel works and rolling-mills; liquor and distillery products; automobile, including parts; lumber and timber products; furniture and refrigerator manufacturing; car manufacturing and repairing; printing and publishing.

Part III. Interstate Comparisons

§1. **Industries in Which Indiana Ranked First, Second and Third.** From the standpoint of the value of the products, on an interstate comparison basis, Indiana ranks first, second and third in the following:

First rank.	*Second rank.*	*Third rank.*
Sewing-machines.	Calcium light.	Street railroad cars.
Wool pulling.	Cement.	Glass.
	Saws.	Musical instruments.
	Windmills.	Children's carriages and sled
	Carriages, wagons and materials.	

CHAP. V. TRADE PURSUITS.

§§1, 2. **Summarize Trade Pursuits; Specfiic Trade Products.** Commerce and trade engaged 99 of each 1,000 male workers and 81 of each 1,000 female workers in 1910.

Of each 1,000 workers in trade pursuits there were 334 retail dealers, 242 salesmen and saleswomen, 124 clerks in stores, 57 commercial travelers, 50 deliverymen (store), 31 insurance agents, 28 real estate agents, 22 store laborers, 17 bankers and bank officials, 16 newsboys, 12 sales agents. This list includes 933 of the 1,000, the remaining 67 being divided among ten other pursuits.

§3. **Specific Pursuits of Age Groups.** The actual number of boys and girls under 16 in the various trade pursuits was as follows:

	Boys under 16.	*Girls under 16.*
Salesmen	333	155
Clerks in stores	331	196
Laborers and porters	103	
Retail dealers	23	
Delivery boys	343	
Newsboys	1,290	
Meat cutters	2	

CHAP. VI. DOMESTIC AND PERSONAL SERVICE PURSUITS

§§1, 2. **Summarized Pursuits; Specific Pursuits.** Domestic and personal service pursuits engaged 32 of each 1,000 male workers, and 360 of each 1,000 female workers in 1910.

Of each 1,000 workers engaged in domestic and personal service pursuits there were: 296 servants; 123 launderers and laundresses (not in laundry); 77 barbers, hairdressers, and manicurists; 67 cooks; 62 housekeepers and stewards; 55 boarding and lodging-house keepers; 36 waiters; 34 janitors and sextons; 31 laundry operatives; 31 saloon-keepers; 30 bartenders; 28 nurses (not trained); 20 porters (except in stores); 19 restaurant, cafe and lunch-room keepers; 15 hotelkeepers and managers; 13 laborers. This list includes 937 of each 1,000, the remaining 63 being divided among thirteen minor pursuits..

§3. **Specific Work of Age Group.** The actual number of boys and girls under 16 in the domestic and personal service pursuits was as follows:

	Boys under 16.	*Girls under 16.*
Servants	250	2,209
Laundry operatives	13	
Barbers	30	
Waiters	25	66
Janitors	22	
Laborers	32	
Porters	45	
Laundresses	..	43
Manicurists	..	4

CHAP. VII. TRANSPORTATION PURSUITS

§§1, 2. **Summarized Pursuits; Specific Pursuits.** Transportation pursuits engaged 82 of each 1,000 male workers and 25 of each 1,000 female workers in 1910. Of each 1,000 workers engaged in transpor-

tation pursuits, there were: 209 laborers (steam railroad); 192 teamsters (expressmen and draymen); 49 telephone operators; 45 brakemen (steam railroad); 45 locomotive engineers; 43 laborers (road and street building); 40 telegraph operators; 39 switchmen (steam railroad); 37 locomotive firemen; 32 foremen and overseers (steam railroad); 31 conductors (steam railroad); 30 mail carriers; 29 stable hands; 17 motormen (street cars); 17 conductors (street cars); 14 steam railroad inspectors; 14 telegraph linemen. This list includes 843 of each 1,000, the remaining 157 being divided among thirty-four minor pursuits.

§3. **Specific Work of Age Groups.** The actual number of boys and girls under 16 years of age in the transportation pursuits was as follows:

	Boys under 16.	*Girls under 16.*
Laborers	103	...
Ticket and baggage agents	2	...
Teamsters	99	...
Stable hands	66	...
Hack drivers	13	...
Telegraph operators	3	...
Telegraph linemen	2	...
Mail carriers	2	...
Telephone operators	..	138

CHAP. VIII. PROFESSIONAL PURSUITS

§1. **Specific Professional Pursuits.** Professional pursuits engaged 33 of every 1,000 male workers and 128 of every 1,000 female workers in 1910. Of every 1,000 engaged in the professional pursuits, there were: 391 school teachers; 108 physicians and surgeons; 83 musicians and teachers of music; 76 clergymen; 74 lawyers, judges, and justices; 33 trained nurses; 24 dentists; 20 editors and reporters; 19 photographers; 18 civil engineers and surveyors; 16 showmen; 14 draughtsmen; 13 veterinary surgeons; 12 artists, sculptors, and teachers of art; 12 attendants and helpers; 11 actors. This list includes 924 of every 1,000, the remaining 76 being engaged in seventeen minor pursuits.

§2. **Specific Work of Various Age Groups.** The actual number of boys and girls under 16 years of age in the professional pursuits was as follows:

	Boys under 16.	*Girls under 16.*
Musicians	20	35
Reporters	1	
Photographers	5	
Civil engineers	1	
Showmen	16	
Attendants	..	9
Actors	..	17

CHAP. IX. CLERICAL PURSUITS

§1. **Specific Clerical Pursuits.** Clerical pursuits engaged 27 of each 1,000 male workers, and 96 of each 1,000 female workers in 1910. Of each 1,000 workers engaged there were: 321 clerks (not in stores); 313 bookkeepers, cashiers, and accountants; 200 stenographers and typists;

41 shipping-clerks; 41 agents; 32 messengers and errand boys and girls; 25 collectors; 19 canvassers; 9 bundle and cash boys and girls.

§2. **Specific Work of Various Age Groups.** The actual number of boys and girls in the clerical pursuits was as follows:

	Boys under 16.	*Girls under 16.*
Clerks and shipping clerks	181	62
Bookkeepers	22	39
Stenographers and typists	6	61
Agents and collectors	30	3
Messenger, bundle and office boys	765	133

CHAP. X. MINING PURSUITS

§1. **Specific Mining Pursuits.** Mining engaged 28 of each 1,000 male workers in 1910. Of each 1,000 workers so engaged there were: 785 coal mine operatives, 120 quarry operatives, 38 oil and gas well operatives, 20 foremen and overseers, 18 operators.

The list includes 981 of each 1,000, the remaining 19 being divided among nine minor pursuits.

§2. **Specific Work of Various Age Groups.** 511 boys under 16 years were employed as coal mine operatives.

CHAP. XI. PUBLIC SERVICE PURSUITS

§1. **Specific Public Service Pursuits.** Public service pursuits engaged 11 of each 1,000 male workers and 2 of each 1,000 female workers in 1910. Of each 1,000 workers so engaged there were: 174 guards, watchmen, and keepers; 125 officials and inspectors (U. S.); 121 policemen; 101 laborers; 100 firemen; 94 officials and inspectors (county); 93 soldiers, sailors, and marines; 91 officials and inspectors (city); 30 marshals and constables; 18 officials and inspectors (State); 12 detectives. The above listed pursuits include 977 of each 1,000, the remaining 23 being divided among five minor pursuits.

CHAP. XII. RELATIVE IMPORTANCE OF AGRICULTURAL AND INDUSTRIAL PURSUITS

§1. **Comparative Number of Workers in Agriculture and Industry.** In 1910 there were as many workers in industrial as agricultural pursuits.

In 1880, 52.2 per cent of all workers in Indiana were farmers; in 1890, 46.0 per cent; in 1900, 39.0 per cent; in 1910, 32.2 per cent, showing a direct and continued decrease in percentage of agricultural workers. In industrial pursuits, however, in 1880, 17.2 per cent of workers were engaged; in 1890, 20.5 per cent; in 1900, 29.9 per cent; in 1910, 32.2 per cent.*

While in each decade from 1880 to 1910 there was but a very slight percentage of increase in the number of agricultural workers, the greatest in any decade being 1.0 per cent, during the same period of time the percentage increase in industrial workers ranged from 34 to 64.

*Includes mining in 1910, as in the previous years, 1880 to 1910, mining was listed in the census under the manufacturing and mechanical group.

From 1880 to 1890 agricultural workers increased about 1.0 per cent; from 1890 to 1900, considerably less than 1.0 per cent; and from 1900 to 1910, considerably less than 1.0 per cent. During the same period the increase in industrial workers was 44.0 per cent from 1880 to 1890; 34 per cent from 1890 to 1900; 64 per cent from 1900 to 1910.

§2. **New Workers Entering Industry.** Of the increased number of workers in Indiana from 1900 to 1910 one of each 100 was a farmer, and 97 were industrial workers.

From 1880 to 1890, of the increased number of workers 9 were farmers and 37 industrial workers; from 1890 to 1900 practically no additional farmers, but 34 industrial workers; from 1900 to 1910, 1 farmer and 97 industrial workers.

§3. **Decrease in Farms and Farm Acreage.** The number of farms and farm acreage is decreasing, but the number of manufacturing establishments is increasing.

From 1900 to 1910 the number of farms in Indiana decreased 6,412, or 2.9 per cent; farm acreage decreased 519,800 acres, or 1.5 per cent, but the number of manufacturing establishments increased 841, or 11.6 per cent.

§4. **Comparative Value of Agricultural and Manufacturing Pursuits.** Manufactured products were estimated as being worth almost twice as much as agricultural products.

In 1909 all farm products were valued at $339,849*, and manufactured products at $579,075.*

The value of manufactured products increased at a higher rate than agricultural products.

From 1899 to 1909 the value of farm products increased $135,399, or 66.2 per cent, while manufacturing increased $242,003, or 71.8 per cent.

§5. **Value of Farm Property.** The value of all farm property increased over 84 per cent from 1900 to 1910.

In 1900 all farm property was valued at $978,616,471, while in 1910 it was estimated at $1,809,135,238, an increase of $830,517,767, or 84.9 per cent.

Capital invested in manufacturing increased over 131.9 per cent from 1900 to 1910.

In 1900 the capital invested in manufacturing amounted to $219,321,000, while in 1910, $508,717,000 was so invested, an increase of $289,396,000, or 131.9 per cent.

§6. **Industry Now as Important as Agriculture.** From all standpoints the manufacturing and mechanical pursuits in Indiana are as important as the agricultural pursuits.

CHAP. XIII. DEDUCTIONS RELATIVE TO EDUCATION.

Part I. Relative to Population and General Education

§1. **Widely Distributed Responsibilities for General and Vocational Education.** The population of Indiana is widely and evenly distributed over the entire State, thus widely distributing the responsibilities for general and vocational education.

*Expressed in thousands.

§2. **Illiteracy in the Entire Population.** Illiteracy, though reduced considerably since 1910, is still present, and, considering the relatively small percentage of foreign born living in the State, is far too high.

§3. **Stability of Population.** The population of Indiana is fairly stable in character.

§4. **Education for Native White Residents.** The principal problem confronting the Indiana schools is educating native born residents.

§5. **Education for Colored Residents.** The high percentage of illiteracy among colored residents indicates a need for stricter enforcement of compulsory education laws.

§6. **Education for Foreign Born Residents.** Illiteracy among foreign born has increased and schools and employers of labor should cooperate in the establishment of night schools, factory schools, and part-time schools to reduce illiteracy and general ignorance.

Part II. Relative to Industrial Arts for Elementary Schools

§1. **Elementary Period and Fundamentals Concerning Course of Study.** The elementary period is here considered as comprising grades one to six. Courses should be uniform, should contain only facts essential to all people, and should include study of the primal industries.

§2. **Industrial Art in Elementary Grades.** Primal industries are present in Indiana and carried on all over the State, thus forming an apperceptive basis for their study and opportunities for observation.

The primal industries are here interpreted as including food, clothing, wood, metal, clay and earth products. In Indiana in the field of food production and manufacturing there is farming, dairying, fruit growing, stock and poultry raising, etc., and in manufacturing foods there is baking, slaughtering, meat packing, milling, fruit and vegetable canning, sugar refining, and the manufacture of butter and cheese. In textiles there is manufacturing of cotton and woolen goods; in clothing manufacturing there is the manufacture of shoes, hats, suits, coats, dresses, and underwear. In the field of the wood industries we find manufacturing of furniture, refrigerators, carriages, wagons, agricultural implements, etc., and the pursuits of carpentering, wood carving, wheelwrighting, and saw-milling. In the field of the metal industries we have the manufacturing of iron and steel, cutlery, railroad cars and parts, tin and enamel ware, automobiles, sewing-machines and the pursuits of machinists, tin, and coppersmiths, moulders, casters, etc. In the field of clay and earth products we find the manufacturing of lime, cement, brick, tile, terra cotta, pottery, and glass, including the pursuits of mining, marble and stone-quarrying, glass-blowing, etc.

Considering the presence of these primal industrial pursuits carried on all over the State, and that the business of the school is to help introduce children to the social order, there is no reason why schools should continue to squander the valuable time of pupils by having them pursue courses in paper and yarn weaving, basketry, and exercises in wood instead of introducing courses dealing with the primal industries.

Part III. Content of Courses for Pre-Vocational Period for Grammar and High Schools, Junior High Schools, Etc., Based on Occupational Facts

§1. **Fundamental Assumptions.** One of the functions of courses for pupils of the seventh, eighth, and ninth grades is to furnish a wide range of experiences and activities to assist in determining pupils' interests and capacities.

§2. **Local Surveys and Courses of Study.** It is held that local surveys are not needed for determining kinds of pre-vocational courses, since courses looking toward "constant" occupational pursuits in the State are desired in this period.

§3. **General Facts Concerning Courses Based on Occupational Statistics of Indiana.** Pre-vocational schools should include courses pertaining to agricultural, industrial, commercial, household and domestic service, and professional pursuits.

§4. **Courses for Boys.** Courses for boys should include: In the field of agriculture, farming, gardening, dairying, fruit growing, stock raising and forestry; in the industrial pursuits courses in the building trades, metal trades, wood industries, electrical pursuits, printing and publishing, and the manufacturing of clothing; in the commercial pursuits—salesmanship, wholesaling and retailing, importing and exporting, work of agents, telegraph operating, bookkeeping, stenography, collecting, etc.

§5. **Courses for Girls.** A variety of types of courses should be provided for girls in order to assist them in determining aptitudes, interests, and capacities. These courses should include: In the field of agriculture—gardening, greenhouse working, dairying, and poultry raising; in the field of industry—dressmaking, millinery, tailoring, composing, proofreading and bookbinding; in the field of commerce—selling, bookkeeping, stenography, and typing; in the professions (aside from teaching)—nursing, photography, architecture, and social work.

Part IV. Content of Courses for Vocational Schools: Day, Part-Time, and Continuation

§1. **Local Surveys and Courses of Study.** Before vocational schools and courses are established, communities must discover primal occupational pursuits and the type of education needed for these pursuits.

§2. **Courses for Day Vocational Schools.** The constant pursuits in the State of Indiana are suggested in the pre-vocational courses, and these are safe lines for day vocational schools, provided it is found that day vocational courses in these fields are needed in local communities.

§3. **Courses for Part-Time Vocational Schools.** The specific needs for particular part-time classes can be determined only by ascertaining the lines in which young people are employed in the local community.

Part-time courses complementary to the profitable pursuits will be possible for all engaged in the agricultural pursuits, and such courses

would reach about 21,000 youths, the greater number being boys. Complementary part-time vocational education is possible for about one-fourth of those engaged in all other pursuits.

The great need in Indiana is for part-time courses for general education. Such courses are needed immediately for about 10,000 boys and girls. Such courses should be eligible for extra State aid, and the law should be modified to provide adequately for this educational obligation.

Part V. The Need of Vocational Surveys and Analyses

§1. **The Limitations of the Census Data.** The census data were derived in 1909 and 1910, and occupational data concern the State as a whole and cities of over 25,000 inhabitants.

§2. **Local Occupational Surveys.** A simple method must be derived by which local school authorities may themselves obtain data concerning age, sex, nationality, and occupational distribution of workers and their education and educational deficiencies.

§3. **Occupational Analyses.** Occupational studies are vitally needed in mining, stone quarrying, slaughtering and meat packing, in the manufacture of cutlery and surgical instruments, sewing-machines, automobiles, railroad and street cars and car parts, carriages and agricultural implements, and in the chemical industries.

CHAPTER I

FACTS CONCERNING THE PEOPLE OF INDIANA

§1. Population and State Rank

The State of Indiana ranked ninth in the Union on the basis of the number of inhabitants in 1910, having a population of 2,700,876. In 1900, the State ranked eighth, the population being 2,516,462. In 1890, the State rank was eighth, the population being 2,192,404, and, in 1880, the rank was sixth and the population 1,978,301. It is thus noted that Indiana, while gaining substantially in population during the last thirty years, has dropped in rank from sixth to ninth place.

Interstate migration is to a small degree responsible for this loss in rank, the actual loss from this cause to 1910 being recorded as 272,571. Doubtless many other factors are responsible for this loss in rank, but no data are available to determine or evaluate other possible causes. The great number of immigrants settling in several of the other States, and the relatively few locating in this State, is perhaps one of the greatest factors. The paragraph on interstate migration and the section relative to nativity treat these topics in greater detail.

It is further noted that the State has not only lost in rank when compared with the other States, but its own rate of increase has also lowered in the last twenty years. From 1880 to 1890 the actual increase in population was 214,103, or 10.8 per cent; from 1890 to 1900, 324,058, or 14.8 per cent; and from 1900 to 1910, 184,414, or 7.3 per cent. Comparing the percentage of increase in population in Indiana during these years with the average percentage increase in population in the United States as a whole, Indiana has not kept pace in growth, since the average increase of all States from 1890 to 1900 was 20.7 per cent and from 1900 to 1910, 21.0 per cent. Table 1 summarizes the facts relative to population thus far presented.

TABLE 1. POPULATION OF INDIANA FROM 1890 TO 1910

Census.	Total.	State Rank.	Increase in Population. Indiana. Year Periods.	Indiana. Number.	Indiana. Per Cent.	U. S. Per Cent.
1910....	2,700,876	9	1900 to 1910	184,414	7.3	21.0
1900....	2,516,462	8	1890 to 1900	324,058	14.8	20.7
1890....	2,192,404	8	1880 to 1890	214,103	10.8	25.5

§2. Interstate Migration

It was noted in the opening paragraph of this section that up to 1910 Indiana had actually lost through interstate migration. This is in striking contrast to some of the Western and Middle Western States that have gained materially in this way. Of her own native born population still living in 1910, 2,805,516, there were 774,174, or 27.6 per cent, living in other States, leaving 2,031,345 native born living in Indiana. On the other hand, 501,420 persons born in other States were, in 1910, living in Indiana. Thus, up to 1910, Indiana actually lost through interstate migration 272,751, or 7.8 per cent. Table 2 summarizes the facts relative to interstate migration.

TABLE 2. LOSS IN NATIVE POPULATION THROUGH INTERSTATE MIGRATION, INDIANA—1910

	Total Number.	Per Cent of Total.
Born in Indiana..................	2,805,516	....
Living in other States............	774,171	27.6
Living in Indiana................	2,031,345	....
Born in other States, living in Indiana......................	501,420	19.8
Loss through interstate migration.	272,751	7.8

§3. Distribution of Residents in Rural and Urban Communities

As a preliminary measure in determining the kind and character of vocational education needed in a State, the facts relative to the number of residents in rural and urban communities are of great importance. For instance, in those sections where the great

majority of the people live in rural communities the problems of rural life are uppermost and are, therefore, the basis for the kind of vocational education to be recommended. On the other hand, in the centers of population, as a rule, the economic and social interests relate to commercial and industrial activities and the adjustments incident thereto; such problems, therefore, form the basis for certain phases of vocational education.

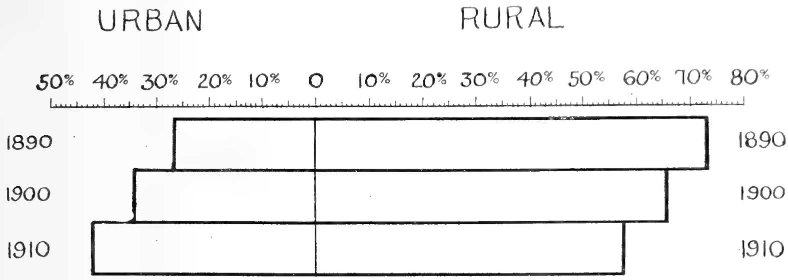
In 1890, it could have been truly said regarding Indiana that from the standpoint of vocational education the needs of the masses were largely for agricultural training, since 73.1 per cent of the entire population resided in rural communities and 52.2 per cent of all wage-earners were engaged in tilling the soil, raising live stock, etc. In 1910, the population was almost evenly divided between rural and urban communities, the ratio being 57.6 per cent to 42.4 per cent, the greater per cent, however, still residing in the country. From 1890 to 1910 there was not only an actual increase in the number of residents in urban places, but an actual decrease in the number of residents in rural places. Thus, from 1900 to 1910 the actual increase in urban population was 267,541, or 30.5 per cent, and the actual decrease in rural population was 83,127, or 5.1 per cent. Comparing Indiana with the United States as a whole, it is seen that this increase in urban population has been general. Table 3 presents the facts concerning urban and rural population and Graph 1 illustrates the variations in distribution from 1890 to 1910.

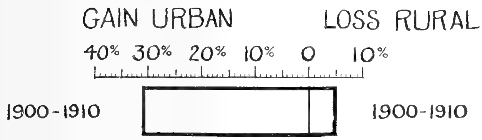
TABLE 3. DISTRIBUTION OF POPULATION IN INDIANA IN URBAN AND RURAL COMMUNITIES, 1890–1910

	1910.		1900.		1890.		INCREASE AND DECREASE* 1900–1910.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
Total......	2,700,876	100.0	2,516,462	100.0	2,192,404	100.0	....	......
Urban.....	1,143,835	42.4	876,294	34.3	590,039	26.9	267,541	30.5
Rural......	1,557,041	57.6	1,640,168	65.7	1,602,365	73.1	*83,127	*5.1
AVERAGE FOR UNITED STATES								
Urban.....	....	46.3	....	40.5	....	36.1	....	......
Rural......	....	53.7	....	59.5	....	63.9	....	......

Graph 1

Distribution of Population in Urban and Rural Communities





The increase in urban population and the decrease in rural population was not primarily due to places of less than 2,500 inhabitants enlarging their corporate limits, thus bringing them into the 2,500 class and apparently reducing the rural population. If this were true there would have been in 1910 more communities of the 2,500 to 5,000 class than in 1900, but it will be noted in Table 4 that in 1900 there were 38 communities of this class and in 1910 only 37. Aside from the decrease in the number of places in this class, a decrease in the actual number of inhabitants is also shown. This decrease amounted to 379 persons. The chief increase has occurred in the cities of the 10,000 to 25,000 class, the actual number of such cities having increased from 10 in 1890 to 14 in 1900 and to 20 in 1910. Aside from the rural population which represents 57.6 per cent of the total population in 1910, cities of this class have for the last twenty years contained a greater percentage of the population than those of any other class. In 1890 this percentage was 6.6 per cent; in 1900, 8.7 per cent, and 1910, 12.6 per cent. The actual number of residents in communities of the various class sizes for the last twenty years will be found in Table 4.

TABLE 4. POPULATION OF INDIANA BY CLASSES OF PLACES, 1890 TO 1900

Classes of Places.	1910 Census.			1900 Census.			1890 Census.		
	Number Places.	Number.	Per Cent of Total Population.	Number Places.	Number.	Per Cent of Total Population.	Number Places.	Number.	Per Cent of Total Population.
100,000 and over	1	233,650	8.7	1	169,164	6.7	1	105,436	4.8
25,000 to 100,000	4	245,421	9.1	4	176,794	7.0	3	116,366	5.3
10,000 to 25,000	20	399,996	12.6	14	218,623	8.7	10	143,945	6.6
5,000 to 10,000	26	188,790	7.0	23	161,751	6.4	18	119,441	5.4
2,500 to 5,000	37	135,978	5.0	38	136,357	5.4	31	104,851	4.8
Rural	....	1,557,041	57.6	....	1,653,773	65.7	....	1,602,365	73.1

Considering the percentage of increase in population from 1900 to 1910 in communities of the various class sizes in Indiana, it will be noted in Table 5 that the decrease in rural population was 5.1 per cent, whereas the increase in places from 2,500 to 25,000 was 26.1 per cent; in places from 25,000 to 100,000, 37.7 per cent, and in places of over 100,000, 36.7 per cent.

TABLE 5. PER CENT OF INCREASE URBAN AND RURAL POPULATION, BY CLASSES

Size of Places by Population.	1910.	1900.	1900–1910.
	Number.	Number.	Per Cent Increase and Decrease.*
100,000 or more	233,650	170,963	36.7
25,000 to 100,000	245,421	178,215	37.7
2,500 to 25,000	664,764	527,116	26.1
Rural	1,557,041	1,653,773	5.1*

Summarizing the facts thus far presented, it has been shown that in the course of the last twenty years Indiana has changed from a State with a primarily rural population to one in which the population is almost equally divided in residence between rural and urban communities. Aside from the fact of mere residence, data contained in subsequent sections show conclusively that the social and economic interests of the State are now as largely related to industrial and mechanical pursuits as to agricultural pursuits, the number of industrial workers now being equal to the number of agricultural, and the value of industrial products far exceeding the value of agricultural products.

§4. Colored and White Residents

To a certain degree the presence of colored residents is bound to condition the kind of vocational education to be provided. Indiana, however, having 60,320 negro residents in 1910, representing 2.2 per cent of the entire population, is not to be classed among those States in which the question of color constitutes a serious educational problem. This is not to say, however, that adequate provision for vocational education should not be made for this

group. This phase of vocational education constitutes an entirely different problem and should receive full consideration. A glance at Table 6 shows that in 1910 there were but 595 orientals in the State, so that this element constitutes no serious problem. Concerning the growth of the negro population it is noted from this table that from 1890 to 1900 it amounted to 12,290, or 27 per cent, and from 1900 to 1910 to only 2,815, or 4.9 per cent. Indiana ranks high among the States on the basis of native born white residents, this percentage in 1910 being 97.7. The summarized facts relative to native and foreign born population are contained in Table 6.

TABLE 6. COLOR AND NATIVITY POPULATION OF INDIANA, 1890 TO 1910

	1910 Census.		1900 Census.		1890 Census.		Increase 1900–1910.		Increase 1890–1910.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
Total	2,700,876	100.0	2,516,462	100.0	2,192,404	100.0	184,414	7.3	324,058	14.8
White	2,639,961	97.7	2,458,502	97.7	2,146,736	97.9	181,459	7.4	311,766	14.5
Negro	60,320	2.2	57,505	2.3	45,215	2.1	2,815	4.9	12,290	27.2
Indian, Chinese, Japanese, etc.	595	....	455	....	453	....	....	....	....	....

§5. Native and Foreign Born Residents

Considering another phase of the nativity of the population, number and per cent of native and foreign born, it will be noted that for the last twenty years the greatest percentage of foreign born residents was 6.7 per cent in the year 1890. In 1900 the percentage lowered to 5.6, and in 1910 rose to 5.9. These facts, as well as the number of native and foreign born, are recorded in Table 7.

TABLE 7. NATIVE AND FOREIGN BORN POPULATION 1890 TO 1900

CENSUS.	Total Population.	Native Born.	Foreign Born.	Per Cent Native Born.	Per Cent Foreign Born.
1910.........	2,700,876	2,541,213	159,663	94.1	5.9
1900.........	2,516,462	2,374,341	142,121	94.4	5.6
1890.........	2,192,404	2,046,199	146,205	93.3	6.7

It is of the greatest significance to discover the nativity of the foreign born living within the State. The presence of foreigners from certain countries is very likely to indicate opportunities for employment along certain lines together with district social conditions, accompanying which are peculiar vocational educational problems. On the other hand, the presence of certain industries is very apt to bring certain types of foreigners. For instance, unlimited opportunities for employment in tailoring shops are apt to bring Russian Jews in great numbers. In Indiana in 1910, 65.3 per cent of all foreigners were born in Northwestern Europe, 30.0 per cent in Southeastern Europe; .7 per cent in Asia; 3.8 per cent in other American countries, and 2 per cent in all other countries. The percentage from Southeastern Europe has increased from 1.6 per cent in 1890 to 5.9 in 1900, and finally to 30.0 per cent in 1910. The number and percentage from all these sections is recorded in Table 8.

TABLE 8. SUMMARY OF NATIVITY OF FOREIGN BORN POPULATION LIVING IN INDIANA, 1890 TO 1900

TOTAL.	1910.		1900.		1890.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
Total, all countries	159,663	100 0	142,121	100.0	146,205	100.0
Northwestern Europe	104,250	65.3	126,447	89.0	134,960	92.3
Southeastern Europe	47,901	30.0	8,409	5.9	2,376	1.6
Asia	1,092	.7	427	.3	161	.1
Other American countries	6,029	3.8	6,043	4.3	5,055	3.5
Countries not recorded	329	.2	387	.3	286	.2

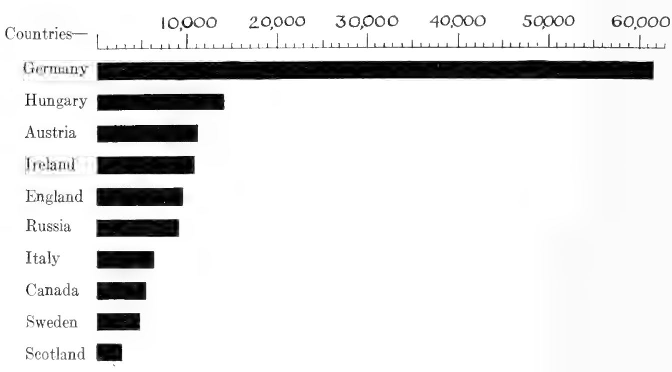
Listing the ten leading countries from which the greatest number of emigrants have come from 1900 to 1910, we have the following in the order of their importance: Germany, Hungary, Austria, Ireland, England, Russia, Italy, Canada, Sweden, Scotland. These ten countries have provided over 90 per cent of all of the foreign population. Germans, from 1900 to 1910, comprised over 40 per cent of the total; from 1890 to 1900, over 50 per cent, and from 1880 to 1890 almost 60 per cent. Table 9 lists these ten leading countries with number of immigrants from each from 1890 to 1900, and Graph 2 pictures these facts for 1910.

TABLE 9. NATIVITY OF FOREIGN BORN POPULATION LIVING IN INDIANA, 1890 TO 1910. NUMBER OF IMMIGRANTS FROM TEN FOREIGN COUNTRIES

COUNTRY.	1910.	1900.	1890.
Germany	62,179	77,811	84,900
Hungary	14,370	1,379	436
Austria	11,831	3,022	832
Ireland	11,266	16,306	20,819
England	9,783	10,874	11,200
Russia	9,599	2,273	576
Italy	6,911	1,327	468
Canada	5,838	5,934	4,954
Sweden	5,081	4,673	4,512
Scotland	3,419	2,805	2,948
All other countries	19,386	15,717	14,560
Total	159,663	142,121	146,205

GRAPH 2

Nativity of Foreign Born Population



Of the 159,322 foreign born white in Indiana in 1910, 111,396 were living in urban communities and 47,926 in rural communities. As recorded in the census, those places having more than 500 foreign born whites were:

Indianapolis	19,767	Elkhart	1,636
South Bend	13,420	Logansport	1,405
East Chicago	10,295	Richmond	1,173
Gary	8,242	Anderson	977
Fort Wayne	7,204	New Albany	878
Hammond	5,553	Muncie	840
Evansville	4,462	Vincennes	816
Michigan City	4,528	Elwood	812
Terre Haute	3,796	Kokomo	719
Lafayette	2,019	Peru	687
Laporte	1,954	Marion	564
Mishawaka	1,803		

§6. **Illiteracy**

In 1910 there was 66,213 illiterates in Indiana, or 3.1 per cent of the total population 10 years and over. An illiterate, according to the census, is a person over 10 years of age unable to write regardless of his ability to read. Of all illiterates in Indiana, 40,955 were native white, being 2.1 per cent of native white population; 18,200 were foreign born whites, being 11.7 per cent of the foreign born white population, and 6,959 were negroes, or 13.7 per cent of the negro population. Illiteracy in Indiana was reduced from 4.6 per cent in 1900 to 3.1 per cent in 1910, the number of native white illiterates being decreased from 63,800 to 40,955, and negroes from 10,954 to 6,959. Illiteracy among foreign born increased in about the same ratio as the increase in foreign population, as there were 16,059 or 11.4 per cent in 1900, and 18,200 or 11.7 per cent in 1910. The following are the summarized facts concerning illiteracy:

ILLITERATES.	1910.		1900.	
	Number.	Per Cent.	Number.	Per Cent.
Total number	66,213	3.1	90,539	4.6
Native white	40,955	2.1	63,800	3.6
Foreign born white	18,200	11.7	16,059	11.4
Negroes	6,959	13.7	10,594	22 6

Compared with other States* as to illiteracy, Indiana's rank is eleventh, there being ten States with a smaller percentage of illiteracy and thirty-eight States with a greater percentage. On the basis of native whites, Indiana's rank was thirtieth, there being twenty-nine States with a smaller percentage and nineteen States with a greater percentage. Considering illiteracy among foreign born whites, Indiana ranked thirty-second, there being thirty-one States with a smaller percentage and seventeen with a greater percentage. On the basis of illiteracy among negroes, Indiana ranked thirty-first, there being thirty States where the percentage was smaller and eighteen where it was greater. These facts are presented in Table 10.

* Including the District of Columbia.

TABLE 10. THE PERCENTAGE OF ILLITERACY IN INDIANA COMPARED WITH OTHER STATES IN 1910 ON THE BASIS OF ILLITERACY IN TOTAL POPULATION, NATIVE WHITES, FOREIGN BORN WHITES, AND NEGROES

Entire Population.		Native Born White.		Foreign Born White.		Negroes.	
State.	Per Cent.	State.	Per Cent.	State.	Per Cent.	State.	Per Cent.
Iowa	1.7	Idaho	0.3	Washington	4.8	Oregon	3.4
Nebraska	1.9	Wyoming	0.3	South Dakota	5.0	Minnesota	3.4
Oregon	1.9	Washington	0.3	Utah	5.9	Washington	4.3
Washington	2.0	Montana	0.4	Georgia	6.0	Wisconsin	4.5
Idaho	2.2	Utah	0.4	Oregon	6.1	Utah	4.8
Kansas	2.2	Nevada	0.4	North Dakota	6.3	Vermont	4.8
Utah	2.5	South Dakota	0.4	Iowa	6.3	North Dakota	4.8
South Dakota	2.9	Oregon	0.4	South Carolina	6.8	Wyoming	5.0
Minnesota	3.0	California	0.5	Idaho	6.9	New York	5.0
North Dakota	3.1	North Dakota	0.5	Nebraska	7.1	Nevada	5.5
Indiana	**3.1**	Minnesota	0.5	Minnesota	7.6	South Dakota	5.5
Wisconsin	3.2	Washington, D. C.	0.5	Nevada	7.6	Michigan	5.7
Ohio	3.2	Massachusetts	0.5	Washington, D. C.	8.2	Connecticut	6.3
Michigan	3.3	Nebraska	0.6	North Carolina	8.3	Idaho	6.4
Wyoming	3.3	Connecticut	0.6	Kentucky	8.3	Montana	7.0
Colorado	3.7	Kansas	0.8	Tennessee	8.3	California	7.1
California	3.7	Iowa	0.8	Wisconsin	8.7	Nebraska	7.2
Vermont	3.7	New York	0.8	Arkansas	8.9	Arizona	7.2
Illinois	3.7	Wisconsin	0.9	Virginia	9.2	Maine	8.0
Maine	4.1	New Jersey	0.9	Michigan	9.3	Massachusetts	8.1
Missouri	4.3	New Hampshire	1.1	Montana	9.4	Colorado	8.6
New Hampshire	4.6	Michigan	1.1	Oklahoma	9.8	Pennsylvania	9.1
Montana	4.8	Pennsylvania	1.3	Wyoming	9.7	Rhode Island	9.5
Washington, D. C.	4.9	Illinois	1.3	California	10.0	New Jersey	9.9
Massachusetts	5.2	Rhode Island	1.3	Missouri	10.1	Iowa	10.3

ENTIRE POPULATION.		NATIVE BORN WHITE.		FOREIGN BORN WHITE.		NEGROES.	
State.	Per Cent.	State.	Per Cent.	State.	Per Cent.	State.	Per Cent.
New York	5.5	Ohio	1.5	Illinois	10.1	Illinois	10.5
New Jersey	5.6	Colorado	1.6	Florida	10.5	New Hampshire	10.6
Oklahoma	5.6	Vermont	1.9	Kansas	10.5	Ohio	11.1
Pennsylvania	5.9	Maine	2.0	Colorado	11.3	Kansas	12.0
Connecticut	6.0	**Indiana**	2.1	Alabama	11.3	Washington, D. C.	13.5
Nevada	6.7	Maryland	2.6	Ohio	11.5	**Indiana**	**13.7**
Maryland	7.2	Missouri	2.9	**Indiana**	**11.7**	New Mexico	14.2
Rhode Island	7.7	Delaware	2.9	Maryland	11.9	Missouri	17.4
Delaware	8.1	Oklahoma	3.3	Massachusetts	12.7	Oklahoma	17.7
West Virginia	8.3	Arizona	4.2	Vermont	13.1	West Virginia	20.3
Texas	9.9	Texas	4.3	Maine	13.7	Maryland	23.4
Kentucky	12.1	Florida	5.0	New York	13.7	Texas	24.6
Arkansas	12.6	Mississippi	5.2	New Hampshire	14.5	Florida	25.5
Tennessee	13.6	West Virginia	6.4	New Jersey	14.7	Delaware	25.6
Florida	13.8	Arkansas	7.0	Mississippi	15.1	Arkansas	26.4
Virginia	15.2	Georgia	7.8	Connecticut	15.4	Tennessee	27.3
North Carolina	18.5	Virginia	8.0	Rhode Island	17.3	Kentucky	27.6
New Mexico	20.2	Tennessee	9.7	Delaware	19.8	Virginia	30.0
Georgia	20.7	Alabama	9.9	Pennsylvania	20.1	North Carolina	31.9
Arizona	20.9	Kentucky	10.0	West Virginia	23.9	Mississippi	35.6
Mississippi	22.4	South Carolina	10.3	Louisiana	24.0	Georgia	36.5
Alabama	22.9	North Carolina	12.3	Texas	30.0	South Carolina	38.7
South Carolina	25.7	Louisiana	13.4	New Mexico	31.0	Alabama	40.1
Louisiana	29.0	New Mexico	14.9	Arizona	31.5	Louisiana	48.4

As recorded in the census, more than 500 illiterates resided in the following cities and towns in 1910:

Indianapolis	5,874
East Chicago	3,017
Evansville	1,938
South Bend	1,405
Gary	1,390
Fort Wayne	1,152
Michigan City	908
Terre Haute	808
Hammond	720
New Albany	550

More than 500 illiterates resided in the following counties in 1910:

Allen	1,766
Bartholomew	796
Cass	644
Clark	911
Clay	1,012
Crawford	658
Daviess	637
Delaware	988
Elkhart	697
Floyd	730
Gibson	981
Grant	1,274
Greene	1,247
Harrison	619
Henry	509
Howard	581
Jackson	761
Jefferson	537
Knox	1,086
Kosciusko	504
Lake	6,065
Laporte	1,606
Lawrence	1,106
Madison	1,356
Marion	6,563
Miami	520
Monroe	888
Morgan	546
Orange	566
Parke	637
Pike	873
Posey	833
Randolph	561
St. Joseph	2,157
Shelby	545
Spencer	749
Sullivan	966
Tippecanoe	786
Vanderburgh	2,103
Vigo	1,814
Warrick	775
Wayne	737

CHAPTER II

THE OCCUPATIONS OF THE PEOPLE OF INDIANA

§1. Methods of Determining Importance of Occupations

The occupations in which people are engaged in a community serve in a general way to indicate the possible lines of employment and also the type of vocational education required. Although the total number of occupations in various States is about the same, the workers in the various groups of occupations may not be evenly and constantly distributed. Thus, while in Mississippi, Idaho, and Massachusetts all of the nine groups of occupations are represented, about 77 per cent of all workers in Mississippi and Idaho are engaged in the agricultural pursuits and 10 per cent in manufacturing; whereas in Massachusetts less than 10 per cent of all workers are engaged in agricultural pursuits and over 55 per cent in the manufacturing and mechanical pursuits. By determining the number of workers in each of the groups of occupations it is possible to determine the productive interests of the community, and a comparison of the number of workers in the various occupations is one preliminary measure of the importance of the pursuits. The number of workers within a given occupation, however, is not to be considered as a final measure of the importance of the occupation from either a social or economic standpoint.

Other measures in determining the relative importance of occupations are the monetary value of the product, value added to the raw material as a result of the manufacturing process, the amount of capital invested, and amount of wages paid. These measures apply with most directness to the agricultural and manufacturing and mechanical pursuits. The last and final measure, more significant than all of the others, is that of the value of the activity to the people of the community, in terms of continued and increased health, happiness, and physical and spiritual well-being. If the product of the pursuit of the occupation represents no social value, or a minimum of social value to the community, then the occupation cannot be regarded as being of positive importance and positive worth; it is rather of negative importance

and negative worth. Thus, in a community of 11,000 workers, 10,000 of which are engaged in the manufacture of alcoholic beverages and 200 in the manufacture of shoes, the work of the 10,000 represents in no wise the most important community activity as the product is of negative importance and worth. The same might hold if the 10,000 were engaged in any of the tobacco manufacturing activities. The work of the 200 group is of unquestioned social worth, and as such takes priority over the larger group engaged in producing alcoholic beverages. Even though an occupation engages the full time of a majority of the people, and the monetary value of the product be great, if the product does not meet a vital human need and contribute to the well-being of the community, the occupation cannot be considered of primal importance.

These measures, then, may be applied to various occupations, in order to determine their relative importance and worth:

1. The number of people engaged in the occupation.
2. The monetary value of the product.
3. The value added to the raw material by the process of manufacturing.
4. Amount of capital invested.
5. Amount of wages paid.
6. The social worth of the pursuit of the occupation.

§2. The Distribution of Workers in the Nine Groups of Occupations to the Communities

The United States census classifies productive activity of males and females as follows:

1. Agricultural.
2. Manufacturing and mechanical.
3. Trade.
4. Domestic and personal service.
5. Transportation.
6. Professional service.
7. Clerical pursuits.
8. Extraction of minerals.
9. Public service.

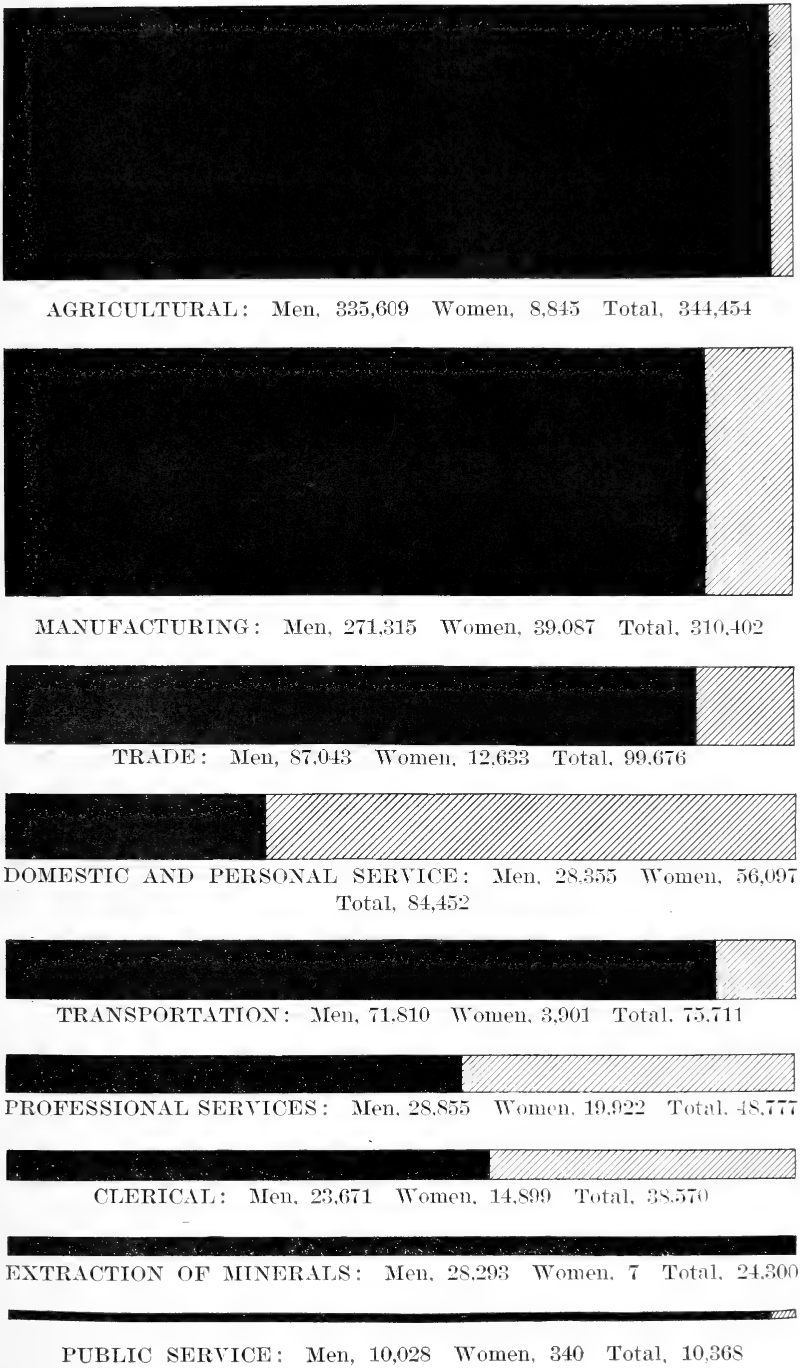
Table 11 shows the number and per cent of males and females in each of the nine groups in Indiana and Graph 3 illustrates these facts.

TABLE 11. DISTRIBUTION OF WORKERS IN GROUPS OF OCCUPATIONS IN INDIANA, 1910

Occupations.	Males and Females.		Males.		Females.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
Total, all occupations......	1,036,710	......	880,979	......	155,731	......
Agricultural...............	344,454	33.2	335,609	38.1	8,845	5.7
Manufacturing and mechanical..................	310,402	29.9	271,315	30.8	39,087	25.1
Trade....................	99,6 6	9.6	87,043	9.9	12,633	8.1
Domestic and personal service....................	84,452	8.1	28,355	3.2	56,097	36.0
Transportation............	75,711	7.3	71,810	8.2	3,901	2.5
Professional service........	48,777	4.7	28,855	3.3	19,922	12.8
Clerical..................	38,570	3.7	23,671	2.7	14,899	9.6
Extraction of minerals......	24,300	2.3	24,293	2.8	7	......
Public service.............	10,368	1.0	10,028	1.1	340	.2

Graph 3

Distribution of Workers in Groups of Occupations



It will be noted that the agricultural pursuits occupy 33.2 per cent of all workers and that 29.9 per cent are engaged in manufacturing. These two groups contain 63.1 per cent of all workers in Indiana; and, adding the related fields of trade and transportation, the total is over 80 per cent.

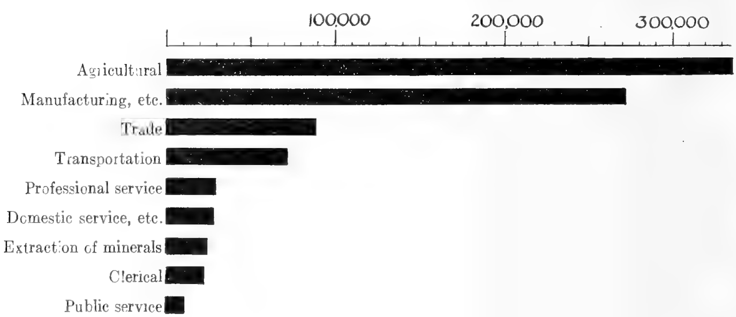
It is necessary to consider males and females separately in this study as it is impossible in only very few occupations to offer the same vocational education for the two sexes.

Males in the Groups of Occupations

Table 11, to which reference has already been made, lists the number of males in the various groups, but Graph 4 presents the facts more strikingly. Again it is noted that the agricultural group contains the largest per cent, this being 38.1 per cent, while the manufacturing and mechanical is second in rank, containing 30.8 per cent.

GRAPH 4

Occupational Distribution of Male Workers

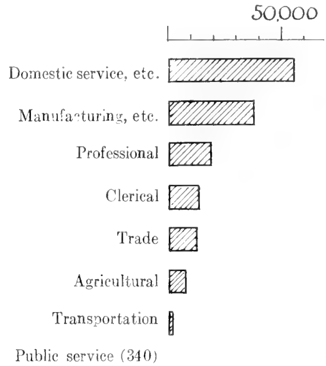


Females in Groups of Occupations

While Table 11 contains the number of females in the group of occupations, the same facts may be studied to better advantage in Graph 5.

GRAPH 5

Occupational Distribution of Female Workers



Women are engaged in the greatest numbers in domestic and personal service, the percentage of the total being 36.0. The next largest group is engaged in manufacturing and mechanical pursuits, the percentage being 25.1 In the order of rank professional service then follows, involving 12.8 per cent of all female wage-earners.

§3. **Occupational Pursuits of Various Age Groups**

Males at Work in Various Age Groups

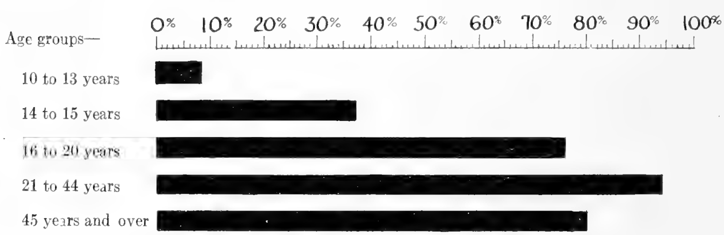
Table 12 shows the actual number of males in various age groups living in 1910 and the number and percent of each age group at work regardless of the kind of work in which they are engaged. Graph 6 pictures these facts.

TABLE 12. TOTAL NUMBER OF MALES IN VARIOUS AGE GROUPS AND NUMBER AND PER CENT AT WORK IN INDIANA, 1910

AGE GROUP.	MALES.		
	Total Number.	Total at Work.	Per Cent at Work.
All over 10 years	1,106,447	880,979	80.3
10 to 13 years	102,400	8,116	7.9
14 to 15 years	51,838	19,572	37.7
16 to 20 years	132,095	101,951	77.1
21 to 44 years	501,586	487,047	96.9
45 years and over	318,528	264,293	82.9

GRAPH 6

Percentage of Males at Work



Concerning the various age groups it is seen that of boys 10 to 13 years old, 7.9 per cent were at work; youths 14 to 15 years, 37.7 per cent; young men 16 to 20 years, 77.1 per cent; men 21 to 44 years, 96.9 per cent, and men 45 years and over, 82.9 per cent. Under the detailed study of the groups of occupations in subsequent sections, the specific pursuits in which the individuals were engaged in each age group are recorded.

Number of Females at Work by Various Age Groups

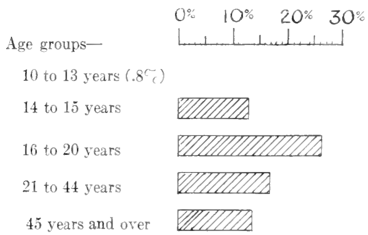
Table 13 and Graph 7 contain the same information for females as indicated in the above paragraph for males.

TABLE 13. TOTAL NUMBER OF FEMALES IN VARIOUS AGE GROUPS AND NUMBER AND PER CENT AT WORK, INDIANA, 1910

AGE GROUPS.	FEMALES.		
	Total Number.	Total Number at Work.	Per Cent at Work.
All over 10 years	1,050,411	155,731	14.8
10 to 13 years	100,734	838	.8
14 to 15 years	50,115	5,167	10.3
16 to 20 years	130,091	35,577	27.0
21 to 44 years	479,254	83,891	17.5
45 years and over	290,217	30,258	10.4

GRAPH 7

Percentage of Females at Work



It will be noted that while most of males in Indiana are wage-earners, most of the females are not. Of girls 10 to 13 years old, .8 per cent were working; 14 to 15 years old, 10.3 per cent; of young women 16 to 20 years old, 27.0 per cent; women 21 to 44 years old, 17.5 per cent, and 45 years and over, 10.5 per cent.

What Males of Various Age Groups Were Doing in 1910

Table 14 records the number and percentage of males in the nine groups of occupations for each age group.

TABLE 14. TOTAL NUMBER OF MALES IN AGE GROUPS AND NUMBER AND PER CENT IN VARIOUS OCCUPATIONS, INDIANA, 1910

	Boys 10 to 13 Years.			Youths 14 to 15 Years.	
	Number.	Per Cent.		Number.	Per Cent.
Total in group	102,400	100.0	Total in group	51,838	100.0
Total at work	8,116	7.9	Total at work	19,572	37.7
Agricultural	6,533	80.5	Agricultural	10,970	56.1
Trade	921	11.4	Manufacturing and mechanical	3,339	17.1
Manufacturing and mechanical	239	3.6	Trade	1,505	7.7
Domestic and personal service	117	1.5	Clerical	855	4.4
Clerical	149	1.9	Mining	557	2.8
Mining	28	......	Domestic and personal service	302	1.6
Transportation	16	......	Transportation	274	1.4
Professional	7	......	Professional	38	.1
Public service	......	......	Public service	7	......
Unknown	106	1.0	Unknown	1,725	8.8

	Young Men 16 to 20 Years.			Men 21 to 44 Years.	
	Number.	Per Cent.		Number.	Per Cent.
Total in group	132,095	100.0	Total in group	501,586	100.0
Total at work	101,951	77.1	Total at work	487,047	96.9
Agricultural	43,414	42.5	Agricultural	158,321	32.5
Manufacturing and mechanical	25,814	25.3	Manufacturing and mechanical	138,094	28.6
Trade	7,170	7.4	Trade	46,249	9.5
Transportation	5,731	5.6	Transportation	44,412	9.1
Clerical	4,405	4.4	Professional	16,077	3.3
Mining	3,205	3.1	Domestic and personal service	16,026	3.2
Domestic and personal service	2,123	2.0	Mining	15,666	3.2
Professional	1,138	1.0	Clerical	14,764	3.0
Public service	263	.2	Public service	4,903	1.0
Unknown	8,688	8.5	Unknown	32,535	6.6

TABLE 14—Continued.

	Men 45 Years and Over.	
	Number.	Per Cent.
Total in group	318,528	100.0
Total at work	264,293	82.9
Agricultural	116,207	43.9
Manufacturing and mechanical	65,216	24.2
Trade	27,292	10.3
Transportation	15,839	6.1
Professional	7,943	3.0
Domestic and personal service	7,148	2.8
Mining	4,757	1.8
Public service	4,094	1.7
Clerical	3,498	1.3
Unknown	12,299	4.7

Work of Boys 10 to 13 Years Old

Of the 102,400 boys between the ages of 10 to 13 living in Indiana in 1910, only 8,116, or 7.9 per cent, were at work. Eighty per cent of this number were employed on farms, and the next largest group, 11.4 per cent, in pursuits incident to trade. Of those at work on farms subsequent data reveal the fact that the greater number are working at home. According to the 1910 census the problem of productive wage-earning in the early years of boyhood is not a serious one.

Work of Youths 14 to 15 Years Old

Of the 51,838 boys of the 14-15 age group, 19,572, or 37.7 per cent, were at work in 1910. The greatest per cent at that age were engaged in agricultural pursuits, the total number being 10,970, or 56.1 per cent. 3,339 boys, or 17.1 per cent, were engaged in manufacturing and mechanical pursuits, and occupations incident to trade involved 1,505, or 7.7 per cent. The remaining workers were distributed in small numbers in the other six pursuits. It is very significant for purposes of education to note that 37.7 per cent of all boys of these ages are at work. In all probability this percentage is far too low since many boys are doubtless engaged in wage-earning who manage to evade the census enumeration.

Work of Young Men 16 to 20 Years Old

The majority of all males between 16 and 20 years were at work in 1910. The actual number was 101,951 of a possible 132,095, or 77.1 per cent. As with the younger age group, the larger group was still employed in agricultural pursuits, the percentage being 42.5 per cent.

Manufacturing and mechanical pursuits employed 25.3 per cent; trade, 7.4 per cent; and the remainder were distrubted as indicated in the table. For the majority of young men these years are devoted to wage-earning and not school education.

Work of Men 21 to 44 Years Old

Ninety-four per cent of all males in this age group were at work in 1900, the total number being 487,047 of a possible 501,586. The percentage in agricultural pursuits was somewhat smaller than in previous years, it being for this period only 32.5 per cent. The percentage in manufacturing and mechanical pursuits materially increased, being 28.6 per cent. Trade and transportation each employ about 9 per cent of all workers, and the remaining 14 per cent were distributed as indicated in the table. This is primarily a period of productive activity for all men. Comparing the percentage in agricultural pursuits in the various age groups, it is noted in these years that it is the lowest, while the percentage in manufacturing and mechanical pursuits is in these years the highest.

Work of Men 45 Years Old and Over

The percentage of workers in these years is lower than in the 21 to 44 age group, it being about 82.9 per cent or 264,293 workers of a possible 315,528. Nearly half of all of these men 45 years and over were engaged in agricultural pursuits and about one-quarter in manufacturing and mechanical pursuits. Ten per cent were engaged in trade; and 6 per cent in transportation. These three activities engage the time of over 85 per cent of the total number of men; the remaining 15 per cent are distributed as indicated. It is interesting to note that while in the 21 to 44 age group the percentage in agriculture was relatively smaller than in previous age groups, the percentage in the 45 years and over group is relatively much larger and the manufacturing and mechanical relatively smaller.

What Females of Various Age Groups Were Doing in 1910

Table 15 shows the actual number and percentage at work in each group of nine groups of occupations.

TABLE 15. TOTAL NUMBER OF FEMALES IN AGE GROUPS AND NUMBER AND PER CENT IN VARIOUS OCCUPATIONS, INDIANA, 1910.

	Girls 10 to 13 Years.			Girls 14 to 15 Years.	
	Number.	Per Cent.		Number.	Per Cent.
Total in group	100,734	100.0	Total in group	50,115	100.0
Total at work	15,838	10.8	Total at work	5,167	10.3
Domestic and personal service	480	57.3	Domestic and personal service	1,924	37.2
Agricultural	230	27.4	Manufacturing and mechanical	1,404	27.1
Manufacturing and mechanical	50	5.9	Trade	341	6.1
Trade	12	1.5	Clerical	290	5.6
Transportation	10	1.2	Agricultural	241	4.9
Professional	10	1.2	Transportation	128	2.6
Clerical	8	.9	Professional	51	1.0
Unknown	38	4.5	Public service	1	......
			Unknown	787	15.2

	Young Women 16 to 20 Years.			Women 21 to 44 Years.	
	Number.	Per Cent.		Number.	Per Cent.
Total in group	130,091	100.0	Total in group	479,254	100.0
Total at work	35,577	27.0	Total at work	83,891	17.5
Domestic and personal service	12,136	34.0	Domestic and personal service	27,406	32.7
Manufacturing and mechanical	7,260	20.4	Manufacturing and mechanical	16,595	19.7
Clerical	4,370	12.3	Professional	14,061	16.7
Trade	3,172	8.1	Clerical	9,745	11.5
Professional	2,806	8.1	Trade	7,068	8.8
Transportation	1,605	4.5	Agricultural	2,239	2.6
Agricultural	667	1.9	Transportation	1,615	1.9
Public service	27	......	Public service	154	.1
Unknown	3,534	10.3	Unknown	5,008	6.0

TABLE 15—Continued.

	Women 45 Years and Over.	
	Number.	Per Cent.
Total in group	290,217	100.0
Total at work	30,258	10.4
Domestic and personal service	13,894	45.9
Manufacturing and mechanical	5,750	18.9
Agricultural	5,079	16.8
Professional	1,817	6.0
Trade	1,328	4.4
Clerical	486	1.6
Transportation	87	.2
Public service	46	.1
Unknown	1,771	5.9

It will be noted that in each of the age groups the domestic and personal service occupations contain the largest number of workers, and the manufacturing and mechanical pursuits the next largest number of workers. Concerning women in industry, while it is impossible to determine from the figures at hand how long individual women remain in industry, the fact is established, however, that from 16 to 44 almost a constant percentage of women wage-earners are here employed. Of those at work in age groups 14 to 15, 27.1 per cent are in industry; 16 to 20, 20.4 per cent; 21 to 44, 19.7 per cent, and 45 and over, 18.9 per cent. These facts are contrary to the usual statement, that while girls may work for a time in industrial pursuits, they drop out before reaching the age of 20 years. All girls entering industry at 16 may drop out at 20, but the facts show that about the same number and percentage between the ages of 21 to 44 years are in industry as between the ages of 16 to 20. These may be entirely different individuals from those 16 to 20 years, but the chances are that they are not. The chances are that this 21 to 44 group is composed of a large number who entered industry from 16 to 20 plus other women who have entered in later life.

Work of Girls 10 to 13 Years Old

In 1910, of the 100,734 girls between the ages of 10 to 13 years, only 838 were listed as at work and 57.3 per cent of these were engaged in domestic and personal service pursuits. About one-fourth of the total number at work in this age group were in

agricultural pursuits and subsequent data show that they were helpers on farms. The numbers in the other groups of occupations are too small for serious consideration.

Work of Girls 14 to 15 Years Old

With a possible 50,115 girls in this group, 5,167, or 10.3 per cent, were at work in 1910. Of this number at work, 1,924, or 37.2 per cent, were in domestic and personal pursuits, and 1,404, or 27.1 per cent, in manufacturing and mechanical pursuits. These two groups embrace over 64 per cent of the girls at work. Trade, clerical, and agricultural pursuits each engage the time of about 5 per cent or 6 per cent of the total number. If the report of the census is accurate, the number of girls at work between the ages of 14 and 15 is much smaller than usually thought to be the case. It is certain from these figures that girls below the age of 16 in wage-earning do not constitute much of a problem in Indiana.

Work of Young Women 16 to 20 Years Old

In this age group almost one-third of all females were at work in 1910, the total number of females in this group being 130,091, and the number at work 35,577. As with the previous age groups, the largest percentage was engaged in domestic and personal service, this group being 34 per cent of the total; manufacturing and mechanical pursuits contain 30.4 per cent; the clerical pursuits 12.3 per cent; trade and professional each about 8 per cent, and the remaining were in pursuits incident to transportation, agriculture, and public service.

Work of Women 21 to 44 Years Old

The number and percentage of women at work between these ages is less than in the 16 to 20 year group, there being, in 1910, 479,254 in this group and 83,891, or 17.5 per cent, at work. Of this number 32.7 per cent were in domestic and personal service, 19.7 per cent in manufacturing and mechanical pursuits, 16.7 per cent in professional, 11.5 per cent in clerical, and 8.8 per cent in trade. There was a notable change of relative numbers in this age group in the professional and clerical pursuits, the number being much higher than in previous and later years.

Work of Women 45 Years Old and Over

The total per cent of women at work in these years was about the same as from 16 to 20, being 10.4 per cent, and representing 30,258 women at work from the total of 290,217. The percentage in domestic and personal service was greater here than in any other period, since almost 50 per cent were so engaged, while the number in manufacturing and mechanical pursuits dropped to less than 20 per cent. The manufacturing and mechancal group was largest in this age group, the total percentage being 18.9.

CHAPTER III

AGRICULTURAL PURSUITS

PART I. GENERAL STATUS OF AGRICULTURE

§1. **Number of Agricultural Workers**

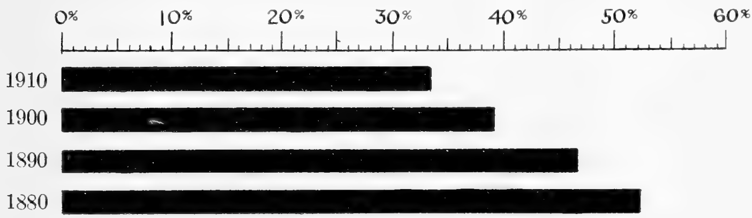
The agricultural pursuits in 1910 from the standpoint of number engaged were the most important in the State of Indiana. A total of 344,454, or 33.2 per cent, of all wage-earners were thus engaged. In 1900 the percentage was 39.2; in 1890, 46.0; and in 1880, 52.2. The total number of wage-earners in the State and the number and per cent in the agricultural pursuits from 1880 to 1910 are recorded in Table 16. The relative decrease in the percentage of workers in the agricultural group is pictured in Graph 8.

TABLE 16. TOTAL NUMBER OF WORKERS IN INDIANA AND NUMBER AND PERCENTAGE ENGAGED IN AGRICULTURAL PURSUITS, 1880 TO 1910

	1910.		1900.		1890.		1880.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
All occupations......	1,036,710	100.0	898,953	100.0	744,303	100.0	635,080	100.0
Agricultural.........	344,454	32.2	342,733	39.2	342,474	46.0	331,783	52.2

GRAPH 8

Percentage of Agricultural Workers, 1880-1910



While from 1880 to 1910 there was an increase of 400,000 workers in the State, or 63 per cent, the increase during this period in the agricultural group was only about 13,000, or 3.9 per cent. During this period by decades the increase in the agricultural pursuits has not kept pace with the increase in the number of wage-earners in the State as noted in Table 17.

TABLE 17. NUMBER AND PERCENTAGE OF INCREASE IN WORKERS IN ALL OCCUPATIONS COMPARED WITH NUMBER AND PERCENTAGE INCREASE IN AGRICULTURAL OCCUPATIONS, INDIANA, 1880 TO 1910

	Increase in Number and Percentage of Workers.					
	1900 to 1910.		1890 to 1900.		1880 to 1890.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
All occupations	137,701	13.+	154,650	17.+	119,223	16.+
Agricultural	1,071	*	247	*	10,691	1.+

*Less than .01 not recorded.

§2. Number of Farms and Extent of Farm Acreage

While there has been but a very small increase in the number of farmers in the last few decades, there were actually fewer farms and a smaller farm acreage in 1910 than in 1900. In 1900 there were 221,897 farms in Indiana, and in 1910 only 215,485, representing a loss of 2.9 per cent. In 1900 there were 21,619,623 acres of farm land, while in 1910 there were only 21,299,832, or a loss of 1.5 per cent. The decade, however, from 1880 to 1890 represented a growth of 2.1 per cent in number of farms and a loss of .3 per cent in farm acreage. From 1890 to 1900 there was a gain of 12.0 per cent in number of farms and 6.2 per cent in farm acreage. Table 18 contains the facts concerning number of farms and farm acreage and percentage of gain and loss in both from 1880 to 1910.

TABLE 18. NUMBER OF FARMS AND FARM ACREAGE, 1880 TO 1910

CENSUS.	FARMS.		LAND IN FARMS.	
	Number of Farms.	Per Cent Increase or Decrease.	Acres.	Per Cent Increase or Decrease.*
1910.....	215,485	2.9	21,299,823	1.5*
1900.....	221,897	12.0	21,619,623	6.2
1890.....	198,167	2.1	20,362,516	0.3*
1880.....	194,013	20.3	20,420,983	12.7*

§3. **Value of Farm Property**

In spite of the fact, however, that there was but a slight increase in the number of farmers and an actual decrease in number of farms and farm acreage, there was an enormous increase in the value of farm property and farm products. In 1900 all farm property in Indiana, including land, buildings, machinery, live stock, etc., was valued at $978,616,471, while in 1910 the estimated value of farm property was $1,809,135,238, or an increase during this period of 84.9 per cent. It will be noted from Table 19 that there is a very decided increase over the two preceding decades.

TABLE 19. INCREASE IN VALUE OF FARM PROPERTY, 1890 TO 1900

	Value all Farm Property.	Per Cent of Increase.
1910..................	$1,809,135,238	84.9
1900..................	$978,616,471	12.6
1890..................	$859,322,787	19.6
1880..................	$726,781,857	23.4

§4. **Value of Farm Products**

The increase in the value of the farm products is no less surprising. Farm products, as listed in the census, include all crops, live stock, dairy products, etc., whether sold or consumed. In 1909 these products in Indiana were listed as being worth $339,-849,366 as compared with $204,450,196 in 1899, representing an increase in valuation of $135,399,170, or about 66 per cent.

Incident to all problems in agriculture is the related problem of farm tenure and ownership. The number of rented farms in various States is quite alarming. In 1890 in Indiana 74.6 per cent of all farms were operated by the owners and managers, while in 1910 this percentage decreased to an even 70 per cent, and the percentage of tenant-operated farms had increased to 30 per cent. The increase in tenant-operated farms constitutes a serious social problem.

§5. Character and Tenure of Farm Ownership

The character and tenure of farm ownership is shown by Table 20.

TABLE 20. CHARACTER OF FARM TENURE AND OWNERSHIP, 1890 TO 1910

	1910.		1900.		1890.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
Farms operated by owners and managers	150,798	70.0	158,449	71.4	147,885	74.6
Farms operated by tenants	64,687	30.0	63,448	28.6	50,282	25.4

Summarizing the tendencies in agriculture in Indiana during the last three decades, it is seen that the percentage of total number of workers engaged in agriculture has been progressively lower since 1880; that there is an actual decrease in the number of farms and amount of farm land, but that in spite of these facts, the value of farm products and farm property has increased enormously.

In the words of the census, "Indiana has passed out of the class of States that are adding materially to their total farm acreage, having less land in farms in 1910 than in 1900. . . . . There was an increase of 154,000, or 7.3 per cent, in population in this State, but a decrease of 319,800 acres, or 1.5 per cent of the acreage of farm land. Since the relative decrease in the number of farms was greater than in farm land, the average size of the farms increased, the increase amounting to 1.4 per cent acres."*

*United States Census, 1910, Vol. 6, p. 461.

PART II. AGRICULTURAL PURSUITS IN INDIANA

§1. Summarized Agricultural Pursuits

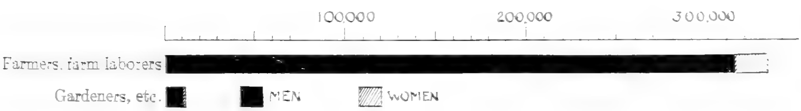
The number of workers in various kinds of agricultural pursuits in Indiana and the number of males and females in each in 1910 was as follows:

	Males	Females	Total
Farmers and farm laborers	323,800	8,136	331,936
Gardeners and greenhouse employes	4,041	333	5,274
Other agricultural pursuits	1,735	5	1,740
Dairying	1,334	117	1,451
Fruit growers and nurserymen	977	44	1,021
Stock raisers	696	38	734
Forestry work and foresters	669	...	669
Poultry raisers and laborers	377	126	503
Fishermen and oystermen	480	1	481
Teamsters and haulers	333	...	333
Florists	250	45	295
Landscape gardeners	17	...	17
Total	335,609	8,845	344,454

These same facts are pictured in Graph 9.

GRAPH 9

Wokers in Agricultural Pursuits



§2. Number of Workers in Specific Agricultural Pursuits

Farmers and farm laborers comprised by far the largest single group under the agricultural pursuits, and it will be noted from the following figures that in this group the greater number are farmers. Laborers working out represented about 25 per cent of the total, and home farm laborers about 15 per cent.

	Males	Females	Total
Farmers	194,073	5,133	199,206
Farm laborers (working out)	79,398	764	80,162
Farm laborers (home farm)	49,337	1,762	51,099
Farm foremen	992	477	1,469
Total	323,800	8,136	331,936

Gardeners and greenhouse workers included the four pursuits listed below.

	Males	Females	Total
Gardeners	3,475	203	3,678
Garden laborers	953	81	1,034
Greenhouse laborers	491	43	534
Garden and greenhouse foremen	22	6	28
Total	4,941	333	5,274

Under the miscellaneous pursuits the greater number are ditchers and the next in importance were corn shellers, hay bailers, and grain threshers.

	Males	Females	Total
Ditchers	1,039	..	1,039
Corn shellers, hay bailers, grain threshers, etc.	634	..	634
Other pursuits (not specified)	43	2	45
Apiarists	19	3	22
Total	1,735	5	1,740

Dairying included proprietors of dairy farms, dairy farm laborers, and dairy farm foremen.

	Males	Females	Total
Dairy farms	761	53	814
Dairy farm laborers	554	58	612
Dairy farm foremen	19	6	25
Total	1,334	117	1,451

In Indiana there were relatively few who were engaged solely in fruit growing or as nurserymen. The numbers were as follows:

	Males	Females	Total
Fruit growers and nurserymen	678	35	713
Orchard and nursery laborers	285	9	294
Orchard, nursery, etc., foremen	14	..	14
Total	977	44	1,021

While stock-raising was probably incident to the farm activities of a large number of farmers, there were relatively very few who classed themselves as stock raisers in 1910.

	Males	Females	Total
Stock raisers	510	38	548
Stock herders, drovers, and feeders	186	..	186
Total	696	38	734

Forestry work in Indiana engaged the time of relatively very few men. The occupations under this head and the workers under each were as follows:

	Males
Lumbermen and raftsmen	421
Woodchoppers and tie cutters	181
Owners, managers of log and timber camps	41
Foremen and overseers (lumber)	18
Foresters	8
Total	669

§3. Specific Agricultural Pursuits of Each Age Group

The specific agricultural pursuits of each age group of males and females are recorded in Table 21.

TABLE 21. SPECIFIC AGRICULTURAL PURSUITS OF EACH AGE GROUP—MALES AND FEMALES

Pursuits.	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
	Age Groups—Males.						
Farm laborers (home)		5,291	7,604	21,011	14,148	1,283	49,337
Farm laborers (working out)		1,193	3,233	19,445	40,718	14,809	79,398
Farmers				2,179	97,768	94,126	194,073
Gardeners				25	1,065	2,385	3,475
Other pursuits	164	49	133	754	4,622	3,604	9,326
Grand total	164	6,533	10,970	43,414	158,321	116,207	335,609
	Age Groups—Females.						
Farm laborers (home)		208	193	429	660	272	1,762
Farm laborers (working out)		22	48	207	340	205	822
Farmers and dairy farmers				27	1,062	4,097	5,186
Other pursuits	389			4	177	505	1,075
Grand total	389	230	241	667	2,239	5,079	8,845

CHAPTER IV

MANUFACTURING AND MECHANICAL PURSUITS

In studying the whole problem of the present status of manufacturing in Indiana, the census data make possible three methods of approach: (1) By the enumeration of the specific occupations in which individuals reported themselves as engaged, these data being obtained by the house-to-house canvass of the census agent; (2) by the facts concerning number of workers, amount of wages, and value of the manufactured products, these data being obtained by a canvass of the various manufacturing establishments; (3) by the facts showing the importance of various lines of industrial activity in this State on the basis of interstate comparisons. The detailed facts under each of these will be presented in the order indicated.

PART I. OCCUPATIONAL DISTRIBUTION OF INDUSTRIAL WORKERS

§1. **Number Employed in Industrial Occupations and General Status of Industrial Pursuits**

In 1900, 310,402 workers were reported as being engaged in industrial pursuits, this number being 29.9 per cent of all workers. In the previous decades from 1880 to 1900, the extraction of minerals was grouped under this head, and upon this basis in 1910 the total would have been 310,402 plus 24,300 or 344,702, or 32.2 per cent of all workers. This is a substantial increase both in total numbers and in percentage of growth over previous years. In 1880 the percentage in this group compared with the total was 17.2 per cent; in 1890, 20.5 per cent; in 1900, 29.9 per cent; and in 1910, 32.2 per cent. Table 22 shows number and percentage of industrial workers for the last thirty years, and Graph 10 pictures these facts.

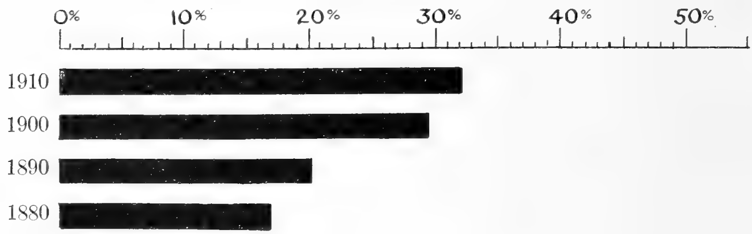
*TABLE 22. NUMBER AND PERCENTAGE OF WORKERS IN MANUFACTURING PURSUITS COMPARED WITH NUMBER OF WORKERS IN ALL PURSUITS, INDIANA, 1880 TO 1910

	1910.		1900.		1890.		1880.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
All occupations......	1,036,710	100.0	898,953	100.0	744,303	100.0	635,080	100.0
Manufacturing and mechanical........	344,702*	32.2	206,611	29.9	153,825	20.5	109,518	17.2

*Includes mining.

GRAPH 10

Percentage of Industrial Workers, 1880-1910



Comparing the percentage of growth in the number of workers in these fields with the growth of the total number of workers in all fields in Indiana during this period, it is seen that it is out of all proportions in favor of the manufacturing pursuits. From 1880 to 1890 the growth in these fields was over 44 per cent; from 1890 to 1900, 34 per cent, and from 1900 to 1910, over 64 per cent. The figures presented in Table 23 give actual numbers as well as percentage of growth in all pursuits and the manufacturing and mechanical pursuits.

TABLE 23. NUMBER AND PERCENTAGE OF INCREASE OF WORKERS OF ALL OCCUPATIONS COMPARED WITH NUMBER AND PERCENTAGE OF INCREASE IN MANUFACTURING AND MECHANICAL OCCUPATIONS

	INCREASE IN NUMBER AND PERCENTAGE OF WORKERS.					
	1900 to 1910.		1890 to 1900.		1880 to 1890.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
All occupations..................	137,757	13.	154,650	17.	119,223	16.
Manufacturing and mechanical....	134,091	64.	52,786	34.	44,304	44.

§2. **Workers in Summarized Industrial Pursuits**

The occupations comprising the manufacturing and mechanical pursuits are grouped in the following general divisions on the basis of the material involved and the type of activity, each division in turn comprising many trades, etc. These general divisions are listed in Table 24 in the order of the total number of workers in each in 1910, and the same facts are pictured in Graph 11. For a detailed and complete classification of workers into skilled, semi-skilled, and unskilled workers, see Summary.

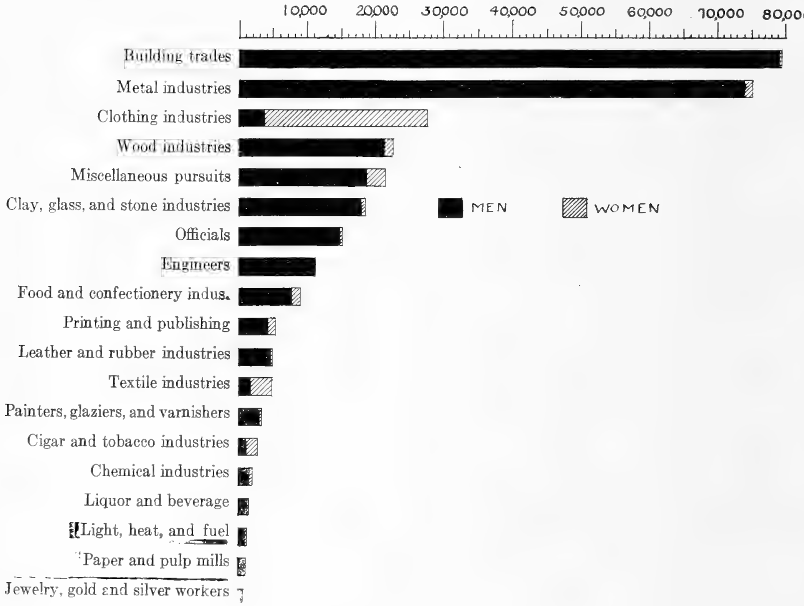
TABLE 24. GENERAL DIVISIONS—MANUFACTURING AND MECHANICAL PURSUITS, INDIANA, 1910

	Males	Females	Total
Building trades	80,111	475	80,586
Metal industries*	74,586	1,354	75,940
Clothing industries	3,565	24,019	27,584
Wood industries†	21,470	1,084	22,554
Miscellaneous pursuits	18,868	2,699	21,567
Clay, glass, and stone industries	17,860	713	18,573
Officials	14,586	504	15,090
Engineers	11,223	5	11,228
Food and confectionery industries	7,717	1,082	8,799
Printing and publishing	4,084	1,229	5,313
Leather and rubber industries	4,709	468	5,177
Textile industries	1,707	3,238	4,945
Painters, glaziers, and varnishers‡	3,340	71	3,411
Cigar and tobacco industries	1,472	1,436	2,908
Chemical industries	1,511	481	1,992
Liquor and beverage industries	1,467	34	1,501
Light, heat, and fuel	1,440	20	1,460
Paper and pulp industries	1,143	141	1,284
Jewelry, gold, and silver	456	34	490
Total	271,315	39,087	310,402

*Exclusive of structural iron workers.
†Exclusive of carpenters.
‡Not incident to the building trades.

GRAPH 11

Workers in Industrial Pursuits



§3. Workers in Specified Industrial Pursuits

1. Building Trades

The two largest groups under the building trades are general laborers and carpenters, comprising about 65 per cent of the total number of workers. The trades and pursuits incident to building construction were as follows in 1910:

	Males	Females	Total
General and not specified laborers..............	29,008	391	29,399
Carpenters	24,254	...	24,254
Painters, glaziers, and varnishers...	8,200	6	8,206
Builders and building contractors..............	5,811	17	5,828
Brick and stone masons........................	3,905	...	3,905
Plumbers and gas and steam fitters............	2,941	...	2,941
Plasterers	1,949	...	1,949
Helpers in building and hand trades............	1,769	7	1,776
Paper hangers	1,435	53	1,488
Apprentices to building and hand trades........	469	1	470
Roofers and slaters..........................	194	...	194
Structural iron workers.......................	176	...	176
Total	80,111	475	80,586

2. *Metal Industries*

The 75,940 workers in the metal industries in Indiana were employed in pursuits as indicated in the following tables. In general it will be noted that the larger per cent of all metal workers were in the skilled metal trades: machinists, moulders, copper and tinsmiths, etc.

SUMMARY OF WORKERS IN METAL INDUSTRIES, INDIANA

	Males	Females	Total
Machinists, blacksmiths, etc.	29,393	37	29,430
Steel works and rolling mill employees	18,903	629	19,532
Blast furnace employees (semiskilled)	12,959	180	13,139
Laborers (especially auto and car shops)	9,869	84	9,953
Copper and tinsmiths	2,219	2	2,221
Workers in metals other than iron and steel	1,243	422	1,665
Total	74,586	1,354	75,940

The various occupations grouped together in the summary are enumerated in detail in the following tables:

MACHINISTS, BLACKSMITHS, ETC.

	Males	Females	Total
Machinists and millwrights	17,410	4	17,414
Blacksmiths	8,604	...	8,604
Boiler-makers	1,861	...	1,861
Buffers and polishers	723	21	744
Grinders	370	6	376
Filers	295	6	301
Tool-makers, die-setters, and sinkers	130	...	130
Total	29,393	37	29,430

STEEL WORKS AND ROLLING-MILL EMPLOYEES

	Males	Females	Total
Other iron and steel works (laborers)	6,766	160	6,926
Other iron and steel works (semiskilled)	4,882	464	5,346
Iron-molders, founders, and casters	5,175	2	5,177
Rollers and roll hands (metal)	1,191	3	1,194
Heaters	624	...	624
Forgemen, hammermen, and welders	184	...	184
Annealers and temperers (metal)	59	...	59
Ladlers and pourers	22	...	22
Total	18,903	629	19,532

BLAST FURNACE EMPLOYEES

	Males	Females	Total
Blast furnaces and rolling-mills (laborers)	9,572	89	9,661
Blast furnaces and rolling-mills (semiskilled)	2,860	91	2,951
Puddlers	334	...	334
Furnacemen and smeltermen	193	...	193
Total	12,959	180	13,139

LABORERS AND SEMISKILLED EMPLOYEES—CAR AND AUTO FACTORIES

	Males	Females	Total
Car and railroad shops (laborers)	3,686	8	3,694
Car and railroad shops (semiskilled)	2,528	14	2,542
Auto factories (laborers)	1,834	24	1,858
Auto factories (semiskilled)	1,821	38	1,859
Total	9,869	84	9,953

COPPER AND TINSMITHS

	Males	Females	Total
Tinsmiths	2,163	2	2,165
Coppersmiths	56	..	56
Total	2,219	2	2,221

WORKERS IN METALS OTHER THAN IRON AND STEEL

	Males	Females	Total
Tinware and enamel ware (semiskilled)	245	292	537
Tinware and enamel ware factories (laborers)	353	44	397
Brass mills	128	15	143
Brass-molders, founders, and casters	140	1	141
Brass mills (laborers)	123	...	123
Other metal factories (semiskilled)	74	39	113
Other metal factories (laborers)	65	31	96
Copper factories (laborers)	71	...	71
Other molders, founders, and casters	33	...	33
Lead and zinc (semiskilled)	8	...	8
Lead and zinc (laborers)	3	...	3
Total	1,243	422	1,665

3. *Clothing Industries*

In the State of Indiana in 1910, 27,584 persons were employed in the various clothing industries, this industry ranking third on the basis of number employed. As listed, manufacturing of textiles is not included, but work of dressmakers, in and out of factories,

milliners, tailors, hatmakers, etc., is included. About 87 per cent of the workers in the clothing industries were females. The exact numbers in the various branches are listed in the following table:

	Males	Females	Total
Dressmakers and seamstresses (not in factory)	3	13,469	13,472
Sewers and sewing-machine operatives (factory)	165	4,356	4,521
Milliners and millinery dealers	96	4,210	4,306
Tailors and tailoresses	2,243	756	2,999
Other clothing factories (semiskilled)	504	651	1,155
Suit, coat, etc. (semiskilled)	315	193	508
Clothing industries (laborers)	104	149	253
Dressmakers and millinery apprentices	1	216	217
Hat factories (semiskilled)	134	19	153
Total	3,565	24,019	27,584

4. *Wood Industries*

The wood industries in 1910 ranked fourth in importance. As previously noted, carpenters and other workers in wood incident to building construction are listed under the building trades. In presenting the following table one is impressed with the fact that there are relatively such a small number of cabinet-makers and such a large number of laborers and semiskilled operatives.

	Males	Females	Total
Furniture, piano and organ factories (semiskilled)	3,767	474	4,241
Saw and planing-mills (laborers)	2,792	17	2,809
Wagon and carriage factories (semiskilled)	2,242	202	2,444
Furniture, piano and organ factories (laborers)	2,239	55	2,294
Cabinet-makers	2,174	...	2,174
Wagon and carriage factories (laborers)	2,002	37	2,039
Other woodworking factories (laborers)	1,469	97	1,566
Sawyers	1,530	1	1,531
Other woodworking factories (semiskilled)	1,311	149	1,460
Saw and planing-mills (semiskilled)	736	52	788
Coopers	724	...	724
Wood-carvers	264	...	264
Wheelwrights	220	...	220
Total	21,470	1,084	22,554

5. *Miscellaneous Pursuits*

Miscellaneous manufacturing and mechanical pursuits include laborers and semiskilled operatives whose exact work is not known, apprentices whose exact apprenticeship is not known, and foremen and workers engaged in a dozen or more industrial activities.

	Males	Females	Total
Other factories (laborers)	6,332	522	6,854
Other factories (semiskilled)	3,079	1,127	4,206
Firemen (except locomotive and fire department)	3,304	...	3,304
Other apprentices	2,185	83	2,268
Electrical supply factories (semiskilled)	459	566	1,025
Other mechanics	971	...	971
Pattern and model-makers	743	6	749
Upholsterers	569	47	616
Electrical supply factories (laborers)	279	64	343
Paper and box factories (semiskilled)	83	217	300
Oilers of machinery	222	...	222
Piano and organ tuners	214	2	216
Clock and watch factories (semiskilled)	98	46	144
Other skilled occupations	109	2	111
Dyers	88	10	98
Enamelers, lacquerers, and japanners	60	7	67
Gunsmiths, locksmiths, and bellhangers	65	...	65
Turpentine distilleries (laborers)	8	...	8
Total	18,868	2,699	21,567

6. *Clay, Glass, and Stone Industries*

The clay and allied industries represented in the State include glass, lime, cement, pottery, brick, tile, marble, stone, etc. These pursuits and the workers in each are enumerated as follows:

	Males	Females	Total
Glass factories (laborers)	3,442	125	3,567
Glass factories (semiskilled)	3,201	303	3,504
Brick, tile, and terra cotta factories (laborers)	3,091	82	3,173
Glass-blowers	2,345	7	2,352
Lime, cement, and gypsum factories (laborers)	1,993	6	1,999
Brick and terra cotta factories (semiskilled)	841	87	928
Stone cutters	834	...	834
Potteries (semiskilled)	525	85	610
Marble and stone (semiskilled)	527	...	527
Marble and stone yards (laborers)	481	7	488
Lime, cement, and gypsum (semiskilled)	340	6	345
Potteries (laborers)	240	5	245
Total	17,860	713	18,573

7. *Officials*

Manufacturing officials are, in every case, listed separately from either office-workers or wage-earners.

	Males	Females	Total
Manufacturers	5,990	73	6,063
Foremen and overseers (manufacturing)	4,961	387	5,348
Officials	689	11	700
Managers and superintendents	2,946	33	2,979
Total	14,586	504	15,090

8. *Engineers*

While there is considerable difference as to whether engineers should be included under professional or the manufacturing and mechanical group, the census enumerates them under the latter, including the phases of engineering below indicated:

	Males	Females	Total
Engineers (stationery)	7,369	1	7,370
Electricians and electrical engineers	3,585	4	3,589
Engineers (stationery)	7,369	1	7,370
Total	11,233	5	11,228

9. *Food and Confectionery Industries*

All phases of food and confectionery, including the slaughtering of cattle, meat-packing, etc., and the actual preparation of various kinds of food are herein listed.

	Males	Females	Total
Bakers	2,243	164	2,407
Slaughter and packing-houses (laborers)	1,471	58	1,529
Millers (grain, flour, and feed)	1,095	1	1,096
Candy factories (semiskilled)	261	341	602
Flour and grain mills (laborers)	475	...	475
Butchers and dressers (slaughter-house)	417	...	417
Slaughtering and meat-packing (semiskilled)	322	46	386
Fruit and vegetable canning, etc. (laborers)	264	61	325
Fruit and vegetable canning, etc. (semiskilled)	126	134	260
Bakeries (semiskilled)	82	150	232
Other food factories (laborers)	165	34	199
Butter and cheese (semiskilled)	188	10	198
Bakeries (laborers)	149	38	187
Other food factories (laborers)	162	25	187
Butter and cheese factories (laborers)	147	5	152
Flour and grist mills (semiskilled)	137	15	152
Sugar factories and refineries (laborers)	10	...	10
Fish canning and packing (laborers)	3	...	3
Total	7,717	1,082	8,799

10. Printing and Publishing

The various arts incident to printing and publishing as well as the related arts are included under this head. It will be noted that over 50 per cent in the group are engaged as compositors, linotypers, and typesetters.

	Males	Females	Total
Compositors, linotypers, and typesetters	2,567	565	3,132
Printing and publishing (S. S.)	573	591	1,164
Pressmen (printing)	485	...	485
Printing and publishing (Lab.)	149	67	216
Engravers	153	2	155
Lithographers	81	2	83
Electrotypers and stereotypers	76	2	78
Total	4,084	1,229	5,313

11. Leather and Rubber Industries

The remanufacture of leather is not developed to any considerable degree in Indiana considering the large slaughtering interests in the State. Hides in great numbers are shipped to other States. The specific pursuits are herein enumerated as follows:

	Males	Females	Total
Shoemakers and cobblers (not in factory)	1,656	10	1,666
Rubber factories (semiskilled)	805	199	1,004
Harness and saddle industries (semiskilled)	883	23	907
Rubber factories (laborers)	692	87	779
Shoe factories (semiskilled)	292	125	417
Tanneries (semiskilled)	174	7	181
Tanneries (laborers)	152	4	156
Shoe factories (laborers)	55	12	67
Total	4,709	468	5,177

12. Textile Industries

With a total of only 4,954 employed in the textile industries, it is obvious that these industries are of minor importance.

	Males	Females	Total
Other occupations (semiskilled)	725	1,132	1,857
Weavers (semiskilled)	263	1,316	1,579
Spinners (semiskilled)	58	278	336
Other textile mills (laborers)	183	131	314
Woolen and worsted mills (laborers)	218	71	289
Winders, wheelers, and spoolers (semiskilled)	13	165	178
Cotton mills (laborers)	131	41	172

Textile Industries—Continued

	Males	Females	Total
Carders, combers, and lappers (semiskilled)....	47	49	96
Bobbin boys, doffers, and carriers (semiskilled).	32	21	53
Beamers, warpers, and slashers (semiskilled)...	10	24	34
Loom fixers	19	..	19
Drawers, rovers, and twisters (semiskilled).....	8	10	18
Total	1,707	3,238	4,945

13. *Painters, Glaziers, and Varnishers*

Those listed under this head are employed in factories rather than in the building trades. The majority of them are doubtless engaged in furniture, carriage, car, and auto factories.

	Males	Females	Total
Painters, glaziers, and varnishers..............	3,340	71	3,411

14. *Cigar and Tobacco Industries*

These industries are of minor importance in Indiana, but it is significant that about 50 per cent of all engaged are women.

	Males	Females	Total
Cigar and tobacco factories (laborers)..........	102	46	148
Cigar and tobacco factories (semiskilled)......	1,370	1,390	2,760
Total	1,472	1,436	2,908

15. *Chemical Industries*

The chemical industries represent a diversity of pursuits, the specified ones being the manufacture of paint, powder, and fertilizer.

	Males	Females	Total
Other chemical factories (laborers)...........	814	87	901
Other chemical factories (semiskilled).........	295	355	650
Powder, cartridges, fireworks, etc., factories (semiskilled)	116	25	141
Powder, cartridges, fireworks, etc., factories (laborers)	106	7	113
Fertilizer factories (laborers)	82	1	83
Paint factories (laborers)	52	2	54
Paint factories (semiskilled)	46	4	50
Total	1,511	481	1,992

16. *Liquor and Beverage Pursuits*

Although ranking high in the monetary value of the products, the manufacture of liquor and beverages engages but relatively few workers.

	Males	Females	Total
Liquor and beverage industries (laborers)......	705	4	709
Breweries (S. S.)	600	9	609
Other liquor and beverage factories (semiskilled)	101	13	114
Distilleries (semiskilled)	61	8	69
Total	1,467	34	1,501

17. *Light, Heat, and Fuel*

Miners of coal are specified under the extraction of minerals, those under this head being engaged in refining oil, manufacturing charcoal and coke, and generating gas and electricity.

	Males	Females	Total
Oil refineries (laborers)	500	4	504
Gas works (laborers)	477	...	477
Electric light and power plants (laborers)......	425	16	441
Charcoal and coke-works (laborers)............	38	...	38
Total	1,440	20	1,460

18. *Paper and Pulp Mills*

The manufacture of paper and pulp is of very minor importance in Indiana.

	Males	Females	Total
Paper and pulp mills (laborers)................	773	38	811
Paper and pulp mills (semiskilled).............	370	103	473
Total	1,143	141	1,284

19. *Jewelry, Gold, and Silver Workers*

Watch-makers and repairers comprise about 70 per cent of all workers in this group, which includes:

	Males	Females	Total
Jewelers and watchmakers (not in factory).....	342	3	345
Gold, silver, and jewelry factories (semiskilled).	60	28	88
Goldsmiths and silversmiths..................	34	2	36
Jewelers and lapidaries.......................	20	1	21
Total	456	34	490

§4. **Specific Industrial Pursuits of Each Age Group of Males and Females**

The specific industrial pursuits in which boys and girls, youths, young men and young women, men and women, together with numbers in each pursuit, are indicated in Table 25.

TABLE 25. SPECIFIC MANUFACTURING PURSUITS OF EACH AGE GROUP—MALES AND FEMALES

(S. S.)=Semiskilled. (Lab.) Laborers

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
Building Trades.							
General laborers		94	519	3,692	14,464	10,239	29,008
Carpenters				928	12,243	11,083	24,254
Painters, glaziers, varnishers				572	5,087	2,541	8,200
Builders, contractors				34	2,847	2,930	5,811
Plumbers, gas, steam-fitters				331	2,172	438	2,941
Brick and stone masons			1	170	2,135	1,599	3,905
Plasterers				78	971	900	1,949
Helpers, building trades		5	43	195	1,025	501	1,769
Paper hangers				145	902	388	1,435
Three other pursuits	839						
Total	839	99	563	6,145	41,846	30,619	80,111
Metal Industries.							
Machinists and Blacksmiths—							
Machinists and millwrights			2	2,532	11,987	2,889	17,410
Blacksmiths				396	4,832	3,376	8,604
Boiler-makers				148	1,359	354	1,861
Filers and grinders			2	88	419	156	665
Buffers and polishers		1	10	141	497	74	723
Tool-makers	130						
Total	130	1	14	3,305	19,094	6,849	29,393

TABLE 25. SPECIFIC MANUFACTURING PURSUITS OF EACH AGE GROUP—MALES AND FEMALES—Continued

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
Steel Works, Rolling-mills—							
Iron foundries (Lab.)			23	170	674	215	1,082
Molders, founders, and casters			2	419	3,905	849	5,175
Iron foundries (S. S.)			27	164	512	132	835
Rollers and roll hands			14	182	847	148	1,191
Furnacemen and smeltermen			16	101	819	237	1,173
Other pursuits	9,447						
Total	9,447		82	1,036	6,757	1,581	18,903
Blast Furnace Employees—							
Blast furnace and rolling mills (Lab.)		3	101	1,183	7,327	958	9,572
Blast furnace and rolling mills (S. S.)		6	37	371	2,098	348	2,860
Two other pursuits	527						
Total	527	9	138	1,554	9,425	1,306	12,959
Car and Auto Shops—							
Car and railroad shops (S. S.)		3	15	235	1,744	531	2,528
Car and railroad shops (Lab.)		1	66	630	2,214	775	3,686
Auto factories (S. S.)			26	374	1,206	215	1,821
Auto factories (Lab.)		1	55	391	1,069	318	1,834
Total		5	162	1,630	6,233	1,839	9,869

Copper and Tinsmiths—							
Tinsmiths	....	....	1	281	1,363	518	2,163
Coppersmiths	56	....	....	....	....	....	....
Total	56	....	1	281	1,363	518	2,163
Other Metals—							
Ten other pursuits	1,243	....	....	....	....	....	....
WOOD INDUSTRIES.							
Furniture, piano and organ (S. S.)	....	12	155	663	2,205	732	3,767
Saw and planing mills (Lab.)	....	4	87	447	1,645	609	2,792
Wagon and carriage (S. S.)	....	4	63	386	1,264	525	2,242
Furniture, piano, and organ (Lab.)	....	3	202	595	1,004	435	2,239
Cabinet-makers	....	....	....	202	1,240	732	2,174
Wagon and carriage factories (Lab.)	....	5	70	426	1,110	391	2,002
Sawyers	....	....	18	165	883	464	1,530
Saw and planing-mills (S. S.)	....	....	19	81	430	206	736
Coopers	....	....	....	36	331	357	724
Three other pursuits	3,264	....	....	....	....	....	....
Total	3,264	28	614	3,001	10,112	4,451	21,470
CLOTHING INDUSTRIES.							
Tailors	....	....	....	166	1,363	714	2,243
Eight other pursuits	1,322	....	....	....	....	....	....
Total	1,322	....	....	166	1,363	714	3,565

TABLE 25. SPECIFIC MANUFACTURING PURSUITS OF EACH AGE GROUP—MALES AND FEMALES—Continued

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
Miscellaneous Pursuits.							
Firemen (not locomotive)			6	245	2,334	719	3,304
Apprentices		43	787	1,532	277	16	2,655
Pattern and model-makers			1	56	462	224	743
Upholsterers			1	111	334	123	569
Agricultural implement (Lab.)			20	134	595	166	915
Three other pursuits	10,682						
Total	10,682	43	815	2,078	4,002	1,248	18,868
Clay, Glass and Stone.							
Glass factories (Lab.)		17	320	951	1,502	652	3,442
Glass factories (S. S.)		18	205	706	1,839	433	3,201
Brick, tile, terra cotta (Lab.)		7	87	495	1,989	513	3,091
Glass-blowers			3	141	1,969	232	2,345
Lime, cement, gypsum (Lab.)		2	16	233	1,395	347	1,993
Brick, tile, terra cotta (S. S.)			23	134	524	160	841
Marble and stone yards (S. S.)			4	48	404	71	527
Potteries (S. S.)			9	82	346	88	525
Stone-cutters				67	489	278	834
Three other pursuits	1,061						
Total	1,061	44	667	2,857	10,457	2,774	17,860

OFFICIALS.							
Manufacturers and officials	....	....	....	38	3,265	3,376	6,679
Managers and superintendents	....	....	....	37	2,017	892	2,946
Foremen and overseers	....	....	....	122	3,444	1,395	4,961
Total	....	....	....	197	8,726	5,663	14,586
ENGINEERS.							
Engineers, stationary	....	1	5	313	4,553	2,497	7,369
Electricians and electrical engineers	....	....	....	501	2,800	284	3,585
Engineers, mechanical	269	....	....	....	....	....	....
Total	269	1	5	814	7,353	2,781	11,223
FOOD AND CONFECTIONERY.							
Bakers	....	....	3	378	1,437	425	2,243
Slaughter and packing-houses (Lab.)	....	....	21	192	1,006	252	1,471
Millers (flour, grain, and feed)	....	....	1	46	538	510	1,095
Fifteen other pursuits	2,908	....	....	....	....	....	....
Total	2,908	....	25	616	2,981	1,187	7,717
PRINTING AND PUBLISHING.							
Compositors, linotypers, typesetters	....	....	....	524	1,591	452	2,567
Printing and publishing (S. S.)	....	....	42	157	318	56	573
Four other pursuits	944	....	....	....	....	....	....
Total	944	....	42	681	1,909	508	4,084

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TABLE 25. SPECIFIC MANUFACTURING PURSUITS OF EACH AGE GROUP—MALES AND FEMALES—Continued

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
LEATHER AND LUMBER.							
Shoemakers (not in factory)			6	54	441	1,155	1,656
Rubber factories (S. S.)			8	125	603	69	805
Rubber factories (Lab.)			29	136	398	129	692
Harness and saddle (S. S.)		1	8	99	418	357	883
Seven other pursuits	673						
Total	673	1	51	414	1,860	1,710	4,709
PAINTERS, GLAZIERS, AND VARNISHERS		2	31	436	2,207	664	3,340
Total		2	31	436	2,207	664	3,340
CIGAR AND TOBACCO INDUSTRIES.							
Cigar and tobacco (S. S.)		3	33	188	848	298	1,370
Cigar and tobacco (Lab.)	102						
Total	102	3	33	188	848	298	1,370
LIQUOR AND BEVERAGES.							
Liquor and beverage (Lab.)			30	110	425	140	705
Breweries (S. S.)		1	30	82	352	135	600
Other semiskilled	162						
Total	162	2	60	192	777	275	1,467

Light, Heat, and Fuel.							
Oil refining (Lab.)	....	....	4	70	370	56	500
Other laborers	940	....	....	....	....	....	....
Total	940	....	4	70	370	56	1,440
Paper and Pulp Mills.							
Paper and pulp mills (Lab.)	....	2	32	153	411	175	773
Paper and pulp mills (S. S.)	370	....	....	....	....	....	....
Total	370	2	32	153	411	175	1,143
Textiles	1,707	....	....	....	....	....	....
Chemical	1,511	....	....	....	....	....	....
Jewelry, gold and silver workers	456	....	....	....	....	....	....
Grand total	38,613	239	3,339	25,814	138,094	65,216	271,315

	Age Groups—Females.						
Metal Industries.							
Tinware, enamelware (S. S.)	....	2	39	175	70	6	292
Twenty other pursuits	1,062	....	....	....	....	....	....
Total	1,062	2	39	175	70	6	1,354

TABLE 25. SPECIFIC MANUFACTURING PURSUITS OF EACH AGE GROUP—MALES AND FEMALES—Continued

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
Clothing Industries.							
Apprentices, dressmakers, etc	....	5	94	94	22	1	216
Dressmakers (not factory)	....	....	8	969	8,107	4,385	13,469
Sewers and operatives	....	5	314	1,619	2,150	268	4,356
Milliners, dealers	....	....	88	987	2,640	495	4,210
Tailoresses	....	....	....	113	466	177	756
Shirts, collars, cuffs (S. S.)	....	2	73	166	123	10	374
Other pursuits	638	....	....	....	....	....	....
Total	638	12	577	3,948	13,508	5,336	24,019
Wood Industries.							
Furniture, piano (S. S.)	....	14	59	150	177	74	474
Wagon, carriage (S. S.)	....	....	11	96	89	6	202
Seven other pursuits	408	....	....	....	....	....	....
Total	408	14	70	246	266	80	1,084
Miscellaneous.							
Electrical supply factories (S. S.)	....	1	57	307	200	1	566
Laborers (general)	....	....	16	46	180	149	391
Paper box factories (S. S.)	....	2	36	103	73	3	217
Other pursuits	1,525	....	....	....	....	....	....
Total	1,525	3	109	456	453	153	2,699

CLAY, GLASS, AND STONE.							
Glass factories (S. S.)		1	50	155	93	4	303
Nine other pursuits	410						
Total	410	1	50	155	93	4	713
OFFICIALS.							
Foremen and overseers				60	300	27	387
Other officials	117						
Total	117			60	300	27	504
FOOD AND CONFECTIONERY.							
Candy factories (S. S.)		2	54	183	102		341
Thirteen other pursuits	741						
Total	741	2	54	183	102		1,082
PRINTING AND PUBLISHING.							
Printing, publishing (S. S.)		1	48	284	245	13	591
Compositors, typesetters, etc				215	329	21	565
Four other pursuits	73						
Total	73	1	48	499	574	34	1,229
TEXTILE INDUSTRIES.							
Knitting mills (S. S.)		6	136	457	290	9	898
Woolen, worsted mills (S. S.)		1	51	196	200	22	470
Cotton mills (S. S.)		1	55	219	286	30	591
Other pursuits	1,279						
Total	1,279	8	242	872	776	61	3,238

TABLE 25. SPECIFIC MANUFACTURING PURSUITS OF EACH AGE GROUP—MALES AND FEMALES—Continued.

PURSUITS.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
CIGAR AND TOBACCO INDUSTRIES.							
Cigar and tobacco (S. S.)		7	215	666	453	49	1,390
Cigar and tobacco (Lab.)	46						
Total	46	7	215	666	453	49	1,436
Building trades	475						
Engineers	5						
Painters, glaziers, varnishers	71						
Leather and rubber industries	468						
Chemical industries	481						
Liquor, beverage industries	34						
Light, heat, and fuel	20						
Paper and pulp mills	141						
Jewelry, gold and silver workers	34						
Grand total	8,028	50	7,260	1,404	16,595	5,750	39,087

PART II. SPECIFIC FACTS CONCERNING MANUFACTURING ESTABLISHMENTS

§1. Number of Establishments, Amount of Wages, and Value of Product

As previously indicated, the second measure of industrial activities relates to the number of manufacturing establishments and workers engaged in these establishments, value of the various manufactured products, etc. Table 26 indicates these and other facts from 1899 to 1909.

TABLE 26. NUMBER OF MANUFACTURING ESTABLISHMENTS, WAGE-EARNERS, WAGES, VALUE OF PRODUCT, AND PERCENTAGE OF INCREASE; INDIANA, 1899, 1904, 1909

CENSUS.	Establishments.	Wage-Earners.	Wages.*	Value of Product.*	Census.	PERCENTAGE OF INCREASE.	
						Wage-Earners.	Value of Product.
1909	7,969	186,984	95,510	579,075	1899 to 1909	35.4	71.8
1904	7,044	154,174	72,058	393,954	1904 to 1909	21.3	47.0
1899	7,128	139,017	59,280	337,072	1899 to 1904	10.9	16.9

*Expressed in thousands.

During the decade, 1899 to 1909, the number of manufacturing establishments increased from 7,128 to 7,969; the number of wage-earners from 139,017 to 186,984; the wages expressed in thousands from \$59,280 to \$95,510; the value of the products expressed in thousands from \$337,072 to \$579,075. These years clearly brought a wonderful development and expansion of industrial activities in Indiana. This development in Indiana was in keeping with the industrial growth of the country as indicated in Table 27.

TABLE 27. PERCENTAGE OF INCREASE OF WAGE-EARNERS, VOLUME OF PRODUCTS, AND VALUE ADDED BY MACHINERY OF UNITED STATES AS A WHOLE AND INDIANA, 1899 TO 1909

	WAGE-EARNERS.			VALUE OF PRODUCT.			VALUE ADDED BY MACHINERY.		
	1899 to 1909.	1904 to 1909.	1899 to 1909.	1899 to 1909.	1904 to 1909.	1899 to 1904.	1899 to 1909.	1904 to 1909.	1899 to 1904.
United States as a whole.......	40.4	21.0	16.0	81.2	39.7	29.7	76.53	35.5	30.3
Indiana	34.5	21.3	10.9	71.8	47.0	16.9	72.4	41.1	22.3

§2. **Localization of Manufacturing Establishments**

Considering the problem of places in which industrial vocational courses and schools should be established in Indiana, the localization of industrial establishments in various classes of places is an essential factor. This information is given for places of 10,000 population and over and places under 10,000 in Table 28. With 29.7 per cent of the population living in places of over 10,000 and 37.3 per cent of the number of establishments in such places we note that the percentage of wage-earners is 60.3 per cent. Although a greater percentage of wage-earners are to be reached in the places of over 10,000 population, there are, nevertheless, a considerable number who are industrially employed in the places of smaller size; a number sufficiently great to warrant serious consideration and to complicate the problem of the establishment of industrial vocational schools and courses.

TABLE 28. NUMBER OF ESTABLISHMENTS, WAGE-EARNERS, VALUE OF PRODUCT, AND VALUE ADDED BY MACHINERY IN COMMUNITIES OF 10,000 OR OVER IN POPULATION AND UNDER 10,000, INDIANA, 1909

	Total.	Places 10,000 and Over.		Elsewhere.	
		Number.	Per Cent of Total.	Number.	Per Cent of Total.
Population	2,700,876	802,265	29.7	1,898,611	70.3
Number of establishments	7,969	2,975	37.3	4,994	62.7
Average number of wage-earners	186,984	112,658	60.3	74,326	39.7
Value of product	$579,075,046	$348,759,733	60.2	$230,315,313	39.8
Value added by manufacture	$244,700,293	$148,609,815	60.7	$96,090,478	39.3

§3. Number of Boys and Girls and Men and Women Employed in Manufacturing Establishments

The number of boys and girls under sixteen and the adult males and females employed in industrial establishments from 1899 to 1909 are recorded in Table 29. While it will be noted that, in 1899, 2.5 per cent of the total number were under sixteen, in 1909 this percentage was only 1.9. This connotes real social progress and tends to show that child labor is not a serious problem in Indiana.

TABLE 29. NUMBER AND PERCENTAGE OF BOYS AND GIRLS EMPLOYED IN INDUSTRIAL ESTABLISHMENTS, INDIANA, 1899, 1904, 1909

Census.	Total.	Average Number of Wage-Earners.			Per Cent of Total.		
		16 Years and Over.		Under 16 Years, Males and Females.	16 Years and Over.		Under 16 Years, Males and Females.
		Males.	Females.		Males.	Females.	
1909	186,984	161,117	22,255	3,612	86.2	11.9	1.9
1904	154,174	131,551	19,230	3,393	85.3	12.5	2.2
1899	139,017	119,580	15,917	3,520	86.0	14.4	2.5

§4. Numbers Employed in Manufacturing Establishments, Wages Paid, and Value of Products

In Table 30 the facts are presented showing the number of wage-earners employed in all the groups of manufacturing establishments, the amount of wages expressed in thousands, and the value of the products expressed in thousands. It must be remembered that included in this table are only those workers who are employed in factories and manufacturing establishments; thus, carpenters, plumbers, plasterers, etc., are not here enumerated. For the reason stated, these figures cannot be compared with the numbers in the occupational tables, as they are measures of altogether different aspects of the industrial activities.

TABLE 30. MALES AND FEMALES EMPLOYED IN MANUFACTURING ESTABLISHMENTS, AMOUNT OF WAGES, AND VALUE OF PRODUCT, INDIANA, 1909

INDUSTRY.	Wage-Earners, Males and Females.	Wages Paid Expressed in Thousands.*	Value of Product Expressed in Thousands.*
Foundry and machine shops	15,809	8,857	39,884
Car shop construction	12,884	8,081	17,128
Iron and steel works and rolling mills	12,255	8,390	38,652
Furniture and refrigerator	11,284	5,137	18,456
Lumber and timber products	10,317	4,492	23,135
Glass	9,544	4,924	11,593
Carriages and wagons	8,867	4,355	21,655
Auto industry, bodies and parts	6,797	4,131	23,746
Printing and publishing	6,756	3,522	14,356
Agricultural implements	4,749	2,565	13,670
Slaughtering and meat-packing	4,423	2,161	47,289
Cars, street railroad	4,084	1,991	9,498
Clothing (men's), including shirts	4,073	1,305	8,029
Brick and tile	3,788	1,835	4,719
Canning and preserving	3,406	879	8,758
Marble and stone-works	3,283	1,943	5,756
Electrical machinery	3,073	1,361	7,718
Tobacco manufacturing	2,794	1,126	4,155
Bread and bakery products	2,505	1,315	10,209
Cement	2,318	1,280	7,022
Flour and grist-mills	2,298	1,216	40,541
Pottery and terra cotta	2,186	1,190	2,966
Copper, tin, and sheet-iron	2,121	1,065	5,763
Hosiery and knit goods	1,933	687	2,381
Musical instruments	1,667	994	3,686
Liquors, malt	1,594	1,019	8,313
Cotton goods, etc	1,582	478	2,502
Paper and wood pulp	1,501	754	5,202
Stoves and furnaces	1,362	723	2,751
Clothing (women's)	1,291	449	2,058
Leather goods	1,240	205	2,311
Gas, illumination and heat	928	508	3,147
Cooperage and wooden goods	891	382	2,398
Confectionery	885	298	2,558
Glucose and starch	866	480	5,750
Patent medicine	801	354	4,344
Woolen, worsted	776	293	1,570
Paper goods	719	256	1,887
Wire working	689	314	3,161
Coffins, etc	669	313	1,448
Cutlery and tools	572	305	933
Ice manufacturing	563	304	1,311
Mattresses and bed springs	553	257	1,287
Boxes, fancy and paper	550	179	782
Butter, cheese, and condensed milk	488	262	3,957
Brass and bronze products	468	292	1,379
Artificial stone	468	227	851
Boots and shoes	436	159	978
Liquors, distilled	428	269	31,610
Leather, tanning, etc	398	205	2,311
Musical instruments	1,667	994	3,686
Gas and electrical fixtures	342	152	620

TABLE 30. MALES AND FEMALES EMPLOYED IN MANUFACTURING ESTABLISHMENTS, AMOUNT OF WAGES, AND VALUE OF PRODUCT, INDIANA, 1909—Continued

INDUSTRY.	Wage-Earners, Males and Females.	Wages Paid Expressed in Thousands.*	Value of Product Expressed in Thousands.*
Scales and balances	266	163	877
Paint and varnish	200	74	1,108
Millinery and lace	166	59	538
All other industries	21,688	10,428	88,643
Total	186,984	95,511	579,075

*For year specified.

§5. The Principal Manufacturing Interests of Indiana

The five leading manufacturing enterprises of Indiana from the standpoint of number of wage-earners employed are the following:

	Number Wage-earners
Foundry and machine shop products	15,809
Cars and general car shop construction	12,884
Iron and steel works and rolling-mills	12,555
Furniture and refrigerators	11,284
Lumber and timber products	10,317

On the other hand, from the standpoint of the value of the products the five leading manufacturing enterprises are the following:

	Value of Product
Slaughtering and meat-packing	$47,289,469
Flour and grist-mill	40,541,422
Foundry and machine shop products	39,883,774
Iron and steel works and rolling-mills	38,651,848
Liquor and distillery products	31,610,468

PART III. INTERSTATE COMPARISONS

§1. Industries in Which Indiana Ranked First, Second, and Third

Considering the States in the Union in the industries in which Indiana ranks as one of the three leading States, we note that it has first place in the manufacture of sewing-machines, and in wool-pulling; second place in the manufacture of calcium light, cement, saws, windmills, and carriage and wagon materials; and third place in the manufacture of street railroad cars, glass, musical instruments, children's carriages and sleds, and in distilled liquors. Table 31 shows the ranking States in these manufacturing interests.

TABLE 31. RANKING OF STATES IN CERTAIN MANUFACTURING PURSUITS

INDUSTRY.	First Ranking State.	Percentage of Value of Total Product.	Second Ranking State.	Percentage of United States Total Value.	Third Ranking State.	Percentage of United States Total Value.
Sewing-machines	**Indiana**		Ohio	21.1	Connecticut	7.5
Wool-pulling	**Indiana**		Massachusetts		Washington	
Calcium light	Illinois	51.2	**Indiana**		Missouri	
Cement	Pennsylvania	29.8	**Indiana**	11.1	California	10.3
Saws	Pennsylvania	32.2	**Indiana**		Illinois	
Windmills	Illinois	61.2	**Indiana**	20.9	Wisconsin	11.5
Carriages, wagons, and materials	Ohio	13.7	**Indiana**	13.5	Illinois	10.5
Street railroad cars	Pennsylvania	22.2	Illinois	21.8	**Indiana**	7.7
Glass	Pennsylvania	35.6	Ohio	15.6	**Indiana**	12.6
Musical instruments	New Jersey	19.7	Illinois	19.5	**Indiana**	18.9
Children's carriages and sleds	Ohio	22.5	Massachusetts	19.9	**Indiana**	12.9
Distilled liquors	Illinois	27.0	Kentucky	21.7	**Indiana**	15.4

CHAPTER V

TRADE PURSUITS

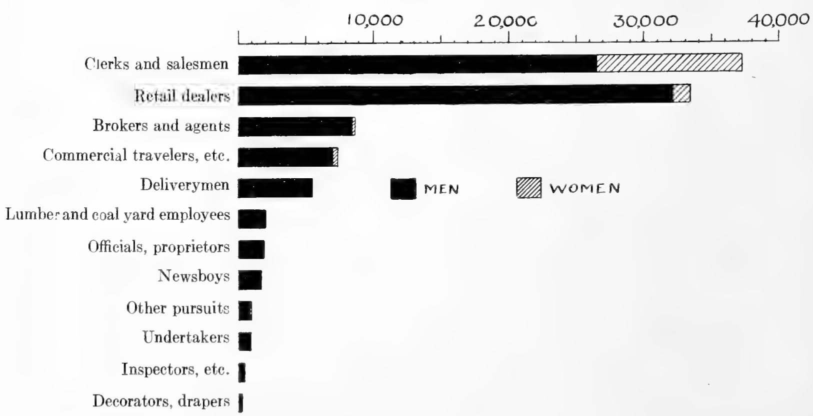
§1. Summarized Trade Pursuits

From the standpoint of the number of people in Indiana engaged in the pursuits incident to commerce and trade, these pursuits ranked third in 1910. The total number of workers was 99,676, of which 87,043 were males and 12,633 females. These pursuits included but 9.6 per cent of all wage-earners in the State. The summarized pursuits included under this head and the number of males and females in each were as follows:

	Males	Females	Total
Clerks, floorwalkers, salesmen and saleswomen..	26,639	10,647	37,286
Retail dealers	32,093	1,237	33,330
Brokers, insurance agents, real estate agents, etc.	8,338	1,210	8,548
Commercial travelers, demonstrators, sales agents and auctioneers..................	6,854	361	7,215
Deliverymen	5,469	1	5,470
Employees lumber yards, coal yards, etc......	1,972	......	1,972
Officials, proprietors, etc......................	1,879	...	1,907
Newsboys	1,632	19	1,651
Other pursuits	948	80	1,028
Undertakers	807	33	840
Inspectors, gaugers, and samplers..............	259	12	271
Decorators, drapers, and window dressers......	153	5	158
Total	87,043	12,633	99,676

GRAPH 12

Workers in Trade Pursuits



§2. Specific Trade Pursuits

The specific occupations under each of the general divisions above enumerated are listed in the following tables:

Clerks, Floorwalkers, Salesmen, and Saleswomen

Under this group the majority of those employed in stores are listed and of these employees by far the greater number are male salesmen.

	Males	Females	Total
Salesmen and saleswomen	17,113	7,118	24,231
Clerks in stores	6,952	3,359	10,311
Laborers, porters, and helpers in stores	2,196	111	2,307
Floorwalkers and foremen in stores	378	59	437
Total	26,639	10,647	37,286

Brokers, Insurance Agents, Real Estate Agents, Etc.

These pursuits are, for the most part, limited to males, as noted from the following table:

	Males	Females	Total
Insurance agents	3,027	65	3,092
Real estate agents and officials	2,817	50	2,867
Bankers and bank officials	1,688	75	1,763
Commission brokers and commission men	426	5	431
Stockbrokers	145	3	148
Brokers and promoters (n. o. s.*)	112	5	117
Loan brokers and loan company officials	101	4	105
Pawnbrokers	22	3	25
Total	8,338	210	8,548

Commercial Travelers, Demonstrators, Sales Agents, and Auctioneers

Commercial travelers and sales agents comprise the greater number under this head.

	Males	Females	Total
Commercial travelers	5,630	77	5,707
Sales agents	1,011	207	1,218
Auctioneers	173	......	173
Demonstrators	40	77	117
Total	6,854	361	7,215

Deliverymen

	Males	Females	Total
Stores (deliverymen)	4,957	1	4,958
Bakeries and laundries (deliverymen	512	......	512
Total	5,469	1	5,470

*Not otherwise specified.

Employees of Lumber Yards, Coal Yards, Etc.

Salaried employees and proprietors are not here listed, the numbers given below being confined to wage-earners, including laborers, etc.

	Males	Females	Total
Lumber yard laborers	821	......	821
Elevator laborers	434	......	434
Coal yard laborers	311	......	411
Stockyards	122	......	122
Warehouse	100	......	100
Foremen, warehouses and stockyards, etc.	84	......	84
Total	1,972	......	1,972

Officials and Proprietors, Etc.

Under this section the number of wage-earners, rated as such, are listed.

	Males	Females	Total
Wholesale dealers, importers and exporters	971	14	985
Proprietors, etc., elevators	328	1	329
Officials of insurance companies	291	5	296
Other proprietors, officials, and managers	214	5	219
Proprietors, etc., warehouse	62	1	63
Employment office keepers	13	2	15
Total	1,879	28	1,907

Newsboys

As noted from the first table under this section, there were in 1910, 1,634 boys and 19 girls engaged in selling newspapers.

Other Pursuits

Meat cutters, miscellaneous occupations, and fruit graders and packers are here included:

	Males	Females	Total
Meat cutters	619	5	624
Other occupations	326	75	401
Fruit graders and packers	3	......	3
Total	948	80	1,028

§3. **Specific Pursuits of Age Groups**

The specific work of males and females in the various age groups is listed in Table 32.

TABLE 32. SPECIFIC TRADE PURSUITS OF EACH AGE GROUP—MALES AND FEMALES.

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
Salesmen, Etc.							
Salesmen (stores)		46	287	2,579	10,591	3,610	17,113
Clerks in stores		17	304	1,843	3,942	846	6,952
Laborers (porters, helpers in stores)		9	94	346	1,308	439	2,196
Floorwalkers	378						
Total	378	72	685	4,768	15,841	4,895	26,639
Retail dealers		9	14	649	17,376	14,045	32,093
Brokers, Agents, Etc.							
Insurance agents, officials				42	1,923	1,353	3,318
Real estate agents, officials				22	1,164	1,631	2,817
Bankers and officials				11	879	798	1,688
Four other pursuits	515						
Total	515			75	3,966	3,782	8,338
Commercial Travelers, Etc.							
Commercial travelers				102	3,602	1,926	5,630
Sales agents			1	25	487	498	1,011
Two other pursuits	213						
Total	213		1	127	4,089	2,424	6,854
Deliverymen		39	304	1,104	3,086	936	5,469

TABLE 32. SPECIFIC TRADE PURSUITS OF EACH AGE GROUP—MALES AND FEMALES—Continued.

PURSUITS.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
COAL, LUMBER YARDS.							
Lumber yards (Lab.)			10	66	463	282	821
Three other pursuits	1,151						
Total	1,151		10	66	463	282	1,972
OFFICIALS, PROPRIETORS.							
Wholesale dealers, etc				11	505	455	971
Other proprietors	908						
Total	908			11	505	455	1,879
Newsboys		801	489	277	42	23	1,632
Other Pursuits—							
Meat cutters			2	72	384	161	619
Two other pursuits	329						
Total	329		2	72	384	161	948

Undertakers	807						
Inspectors, gaugers, etc	259						
Decorators, drapers, etc	153						
Grand total	3,906	921	1,505	7,170	46,249	27,292	87,043
		AGE GROUPS—FEMALES.					
CLERKS AND SALESWOMEN.							
Clerks in stores		3	152	1,136	1,898	170	3,359
Saleswomen (stores)		9	187	2,001	4,391	530	7,118
Two other pursuits	170						
Total	170	12	339	3,137	6,289	700	10,647
Retail dealers			1	30	671	535	1,237
Sales agents			1	5	108	93	207
Nine other pursuits	542						
Grand total	712	12	341	3,172	7,068	1,328	12,633

CHAPTER VI

DOMESTIC AND PERSONAL SERVICE PURSUITS

§1. Summarized Pursuits

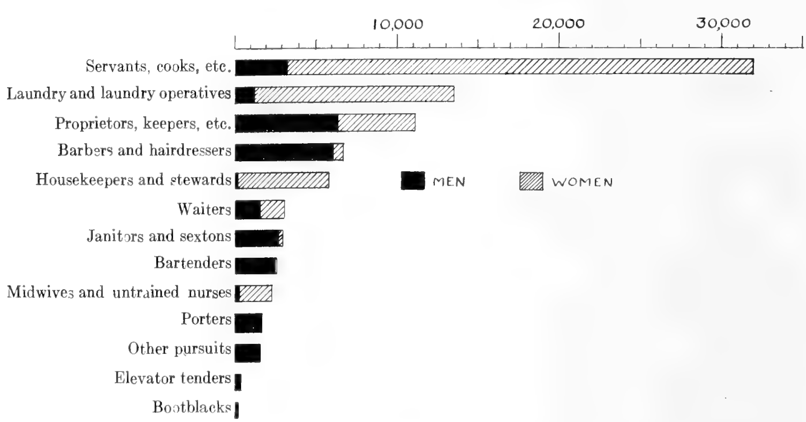
In 1910 the domestic and personal service pursuits ranked fourth on the basis of number employed, the total being 84,452, of which 28,355 were males and 56,097 females. These pursuits engaged 8.1 per cent of all wage-earners in Indiana.

The summarized groups and number of males and females in each are indicated in the table and pictured in Graph 13.

	Males	Females	Total
Servants, cooks, and chambermaids	3,314	28,706	32,020
Laundry and laundry operatives	1,227	12,212	13,439
Proprietors, keepers, etc.	6,353	4,895	11,248
Barbers, hairdressers, and manicurists	6,100	479	6,579
Housekeepers and stewards	212	5,715	5,927
Waiters	1,522	1,512	3,034
Janitors and sextons	2,666	286	2,952
Bartenders	2,533	10	2,543
Midwives and untrained nurses	343	2,138	2,481
Other pursuits	1,767	144	1,911
Porters (except in stores)	1,744	......	1,744
Elevator tenders	334	......	334
Bootblacks	240	......	240
Total	28,355	56,097	84,452

GRAPH 13

Workers in Domestic and Personal Service Pursuits



§2. **Specific Pursuits**

The special occupations under each of the general divisions are enumerated in the following tables:

Servants, Chambermaids, and Cooks

Servants comprised the largest single group under this head. There were about one-fifth as many cooks as servants.

	Males	Females	Total
Servants	1,440	23,585	25,025
Cooks	1,485	4.228	5,713
Charwomen and cleaners	137	387	524
Chambermaids	......	506	506
Coachmen and footmen	252	......	252
Total	3,314	28,706	32,030

Launderers and Laundry Operatives

The facts in the following table show that five times as many women are engaged in laundry work outside of regular laundries as are at work in laundries:

	Males	Females	Total
Launderers and laundresses (not in laundry)	300	10,130	10,430
Laundry operatives	604	2,074	2,678
Laundry owners, officials, and managers	323	8	331
Total	1,227	12,212	13,439

Proprietors, Keepers, Etc.

The following table shows the number of proprietors, keepers, etc., of lodging-houses, saloons, cafes, and the like.

	Males	Females	Total
Boarding and lodging-house keepers	506	4,185	4,691
Saloonkeepers	2,633	24	2,657
Restaurant, cafe, and lunchroom keepers	1,426	253	1,679
Hotel keepers and managers	921	354	1,275
Billiard and poolroom keepers	500	6	506
Cemetery keepers	186	......	186
Bathhouse keepers and attendants	99	60	159
Dance hall, skating rink, etc., keepers	82	13	95
Total	6,353	4,895	11,248

Midwives and Nurses (not trained)

The following table shows the number of midwives and untrained nurses:

	Males	Females	Total
Nurses (not trained)	343	2,095	2,438
Midwives	......	43	43
Total	343	2,138	2,481

Other Pursuits

Other pursuits, not classified, are shown in the following table:

	Males	Females	Total
Laborers (domestic and personal)	1,033	80	1,113
Cleaners and renovators (clothing, etc.)	312	55	367
Bell boys, chore boys, etc	351	8	359
Other occupations	44	1	45
Umbrella menders and scissors grinders	27	......	27
Total	1,767	144	1,911

§3. **Specific Work of Age Groups**

The specific occupations of males and females of the various age groups are listed in Table 33.

TABLE 33. SPECIFIC DOMESTIC AND PERSONAL SERVICE PURSUITS OF EACH AGE GROUP—MALES AND FEMALES.

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
SERVANTS, ETC.							
Servants, cooks, etc.	....	99	151	560	2,043	675	3,528
LAUNDRY WORKERS.							
Laundry operatives	....	1	12	87	416	88	604
Two other pursuits	623	....	....	....	....	....	....
Total	623	1	12	87	416	88	1,227
PROPRIETORS, KEEPERS, ETC.							
Boarding and lodging-house keepers	....	....	....	3	193	310	506
Saloon-keepers	....	....	....	7	1,713	913	2,633
Restaurant, cafe and lunch-room keepers	....	....	....	31	860	535	1,426
Billiard and pool-room keepers	....	....	....	9	350	141	500
Hotel keepers and managers	....	....	....	9	364	548	921
Three other pursuits	367	....	....	....	....	....	....
Total	367	....	....	59	3,480	2,447	6,353
Barbers, etc	....	5	25	497	4,357	1,216	6,100
Housekeepers and stewards	212	....	....	....	....	....	....
Waiters, etc	....	2	23	288	1,068	141	1,522
Janitors and sextons	....	5	17	103	1,070	1,471	2,666
Bartenders	....	....	....	92	1,965	476	2,533
Nurses (untrained)	343	....	....	....	....	....	....

TABLE 33. SPECIFIC DOMESTIC AND PERSONAL SERVICE PURSUITS OF EACH AGE GROUP—MALES AND FEMALES—Continued.

PURSUITS.	Age Groups—Females.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
Other Pursuits.							
Laborers, domestic and personal	....	1	31	146	487	368	1,033
Four other pursuits	520	....	....	....	....	....	....
Total	520	1	31	146	487	368	1,033
Porters	....	4	43	291	1,140	266	1,744
Elevator tenders	334	....	....	....	....	....	....
Bootblacks	240	....	....	....	....	....	....
Grand total	2,639	117	302	2,123	16,026	7,148	28,355
	Age Groups—Females.						
Servants, Etc.							
Servants	....	468	1,736	9,376	13,116	3,631	28,327
Charwomen and cleaners	....	....	5	37	208	137	3,797
Total	....	468	1,741	9,413	13,324	3,768	28,706
Laundry Employees.							
Laundresses (not in laundry)	....	5	38	425	5,296	4,366	10,130
Laundry operatives	....	1	81	686	1,090	216	2,074
Total	....	6	119	1,111	6,386	4,582	12,212

PROPRIETORS, KEEPERS, ETC.							
Boarding and lodging-house keepers				39	1,992	2,154	4,185
Restaurant, cafe, lunch-room keepers				2	159	92	253
Hotel keepers and managers				4	147	203	354
Three other pursuits	103						
Total	103			45	2,298	2,449	4,895
Barbers, hairdressers, manicurists		1	3	62	336	77	479
Housekeepers and domestics				803	2,936	1,976	3,715
Waitresses		5	61	570	824	52	1,512
Janitors and sextons				8	152	126	286
Bartenders	10						
Midwives, nurses (not trained)				124	1,150	864	2,138
Other pursuits	144						
Grand total	257	480	1,924	12,136	27,406	13,894	56,097

CHAPTER VII

TRANSPORTATION PURSUITS

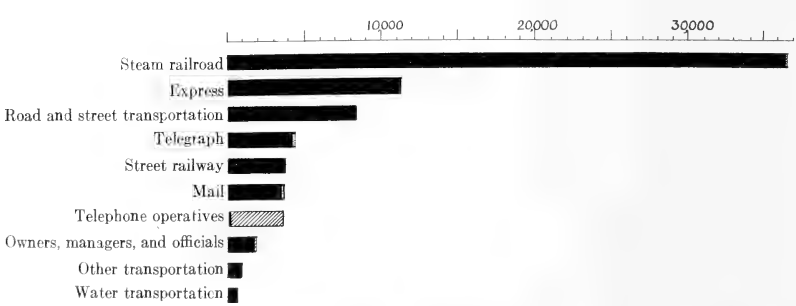
§1. Summarized Pursuits

The transportation pursuits in 1910 in Indiana ranked fifth in the order of importance on the basis of the number employed. There were 75,711 workers so engaged, 71,810 being males and 3,901 females. The employees in this group were 7.3 per cent of all employees in all occupations. The summarized groups with number of males and females in each are indicated in the table and pictured in Graph 14.

	Males	Females	Total
Steam railroad	36,832	107	36,939
Express	11,203	10	11,213
Road and street transportation	8,390	5	8,395
Telegraph	4,229	213	4,442
Street car railroad	3,844	7	3,851
Mail	3.723	53	3,776
Telephone operatives	284	3,445	3,729
Owners, managers, and officials	1,817	43	1,861
Other transportation	914	18	932
Water transportation	574	......	574
Total	71,810	3,901	75,712

GRAPH 14

Workers in Transportation Pursuits



§2. Specific Pursuits

Almost 50 per cent of all transportation workers were employed in pursuits incident to operating steam railroads. The occupations represented and number in each in 1910 were as follows:

	Males	Females	Total
Steam railroad laborers	15,834	42	15,876
Locomotive engineers	3,428	......	3,428
Brakemen	3,403	......	3,403
Switchmen and flagmen (steam)	2,979	2	2,981
Locomotive firemen	2,727	......	2,727
Foremen and overseers (railroad)	2,427	13	2,440
Conductors (steam railroad)	2,339	......	2,339
Steam road (inspectors)	1,068	5	1,073
Steam railroad (semiskilled)	711	9	720
Ticket and station agents	704	35	739
Boiler washers and engine hostlers	364	......	364
Baggagemen	354	......	354
Yardmen (steam railroad)	319	......	319
Freight agents	175	1	176
Total	36,832	107	36,939

Express Employees

Draymen and teamsters comprise the greater number of express employees.

	Males	Females	Total
Draymen, teamsters, and expressmen	10,802	3	10,805
Agents (express companies)	218	7	225
Express messengers	183	......	183
Total	11,203	10	11,213

Road and Street Transportation

The number of workers in road and street transportation is here shown:

	Males	Females	Total
Road and street building and repair (laborers)	3,278	......	3,278
Hostlers and stable hands	2,215	......	2,215
Livery stable keepers and managers	1,365	4	1,369
Carriage and hack drivers	601	1	602
Chauffeurs	600	......	600
Street cleaning (laborers)	189	......	189
Road and street building and repairing (foremen and overseers)	142	......	142
Total	8,390	5	8,395

Telegraph Employees

Operators comprise over 50 per cent of all telegraph employees, and linemen about 25 per cent.

	Males	Females	Total
Telegraph operators	2,890	197	3,087
Telegraph and telephone linemen	1,088	......	1,088
Telegraph messengers	154	8	162
Telegraph and telephone companies (foremen and overseers)	97	8	105
Total	4,229	213	4,442

Street Car Railroads

Motormen and conductors comprise about two-thirds of those employed by street railroads.

	Males	Females	Total
Motormen	1,350	......	1,350
Conductors street road	1,326	......	1,326
Street railroad (laborers)	932	6	938
Street railroad (semiskilled)	130	1	131
Street road (inspectors)	74	......	74
Switchmen and flagmen (street)	32	......	32
Total	3,844	7	3,851

Mail Employees

Mail carriers comprise approximately three-fourths of all mail employees.

	Males	Females	Total
Mail carriers	2,946	53	2,999
Railway mail clerks	777	......	777
Total	3,723	53	3,776

Owners, Managers, and Officials

Officials and superintendents of steam railroads outnumber other classes in this group.

	Males	Females	Total
Steam railroad (officials and superintendents)	664	......	664
Telegraph and telephone proprietors, officials, and managers (n. o. s.*)	393	38	431
Proprietors and managers of transportation companies	330	3	333
Garage keepers and managers	144	......	144
Other transportation (proprietors and officials)	95	2	97
Foremen of livery and transportation companies	97	......	97
Street railroad (officials and superintendents)	94	......	94
Total	1,817	43	1,860

*Not otherwise specified.

Other Transportation

Laborers represent the most numerous class in this group.

	Males	Females	Total
Other transportation (laborers)	744	5	749
Other transportation (semiskilled)	85	12	97
Other transportation (inspectors)	64	1	65
Other transportation (foremen and overseers)	21	......	21
Total	914	18	932

Water

The following table shows the number of men employed in water transportation pursuits:

	Males	Total
Sailors and deckhands	275	275
Captains, masters, mates, and pilots	158	158
Longshoremen and stevedores	77	77
Water transportation (other pursuits)	41	41
Boatmen, canalmen, and lock-keepers	23	23
Total	574	574

§3. Specific Work of Various Age Groups

The specific occupations of males and females in various age groups are indicated in Table 34.

TABLE 34. SPECIFIC TRANSPORTATION PURSUITS OF EACH AGE GROUP—MALES AND FEMALES

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
Steam Railroad.							
Laborers (steam railroad)	...	...	81	2,140	10,675	2,938	15,834
Locomotive engineers	...	...	...	23	2,282	1,123	3,428
Foremen and overseers (railroad)	...	...	...	13	1,483	931	2,427
Brakemen	...	...	...	263	2,976	164	3,403
Locomotive firemen	...	...	...	278	2,381	68	2,727
Switchmen, flagmen (steam railroad)	...	...	...	114	1,780	1,085	2,979
Conductors (steam railroad)	...	...	...	9	1,678	652	2,339
Inspectors	...	...	...	56	709	303	1,068
Ticket and station agents	...	...	1	62	482	159	704
Baggage and freight agents	...	...	1	36	298	194	529
Two other pursuits	1,394	...	...	...	...	...	...
Total	1,394	...	83	2,994	24,744	7,617	36,832
Express.							
Draymen, teamsters, expressmen	...	8	91	945	6,222	3,536	10,802
Two other pursuits	401	...	...	...	...	...	...
Total	401	8	91	945	6,222	3,536	11,203

ROAD AND STREET.							
Hostlers and stable hands	....	5	61	326	1,223	600	2,215
Livery-stable keepers, managers	....	....	....	11	704	650	1,365
Carriage and hack drivers	....	1	12	71	353	164	601
Chauffeurs	....	....	....	171	402	27	600
Laborers (road and street)	....	1	16	262	1,925	1,074	3,278
Two other pursuits	331	....	....	....	....	....	....
Total	331	7	89	841	4,607	2,515	8,390
TELEGRAPH.							
Telegraph operatives	....	....	3	546	2,097	244	2,890
Telegraph and telephone linemen	....	....	2	96	905	85	1,088
Two other pursuits	251	....	....	....	....	....	....
Total	251	....	5	642	3,002	329	4,229
STREET CAR RAILROAD.							
Motormen	....	....	....	22	1,117	211	1,350
Conductors (street railroad)	....	....	....	73	1,165	88	1,326
Laborers (street railroad)	....	1	4	110	571	246	932
Three other pursuits	236	....	....	....	....	....	....
Total	236	1	4	205	2,853	545	3,844
MAIL.							
Railway mail clerks	....	....	....	12	613	152	777
Mail carriers	....	....	2	78	1,937	929	2,946
Total	....	....	2	90	2,550	1,081	3,723

TABLE 34. SPECIFIC TRANSPORTATION PURSUITS OF EACH AGE GROUP—MALES AND FEMALES—Continued.

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
Owners, Managers, Etc.							
Steam railroad officials				14	434	216	664
Six other pursuits	1,153						
Total	1,153			14	434	216	1,817
Other transportation	914						
Water transportation	574						
Telephone operatives	284						
Grand total	5,538	16	274	5,731	44,412	15,839	71,810
	Age Groups—Females.						
Telephone Operators.							
Telephone operatives		10	128	1,605	1,615	87	3,445
Eight other pursuits	456						
Total	456	10	128	1,605	1,615	87	3,901

CHAPTER VIII

PROFESSIONAL PURSUITS

§1. Specific Professional Pursuits

In 1910 in Indiana there were 48,777 in the professional pursuits, 28,855 being males and 19,922 females. On the basis of the number employed, these pursuits ranked sixth, the percentage of the total number of workers being 4.7.

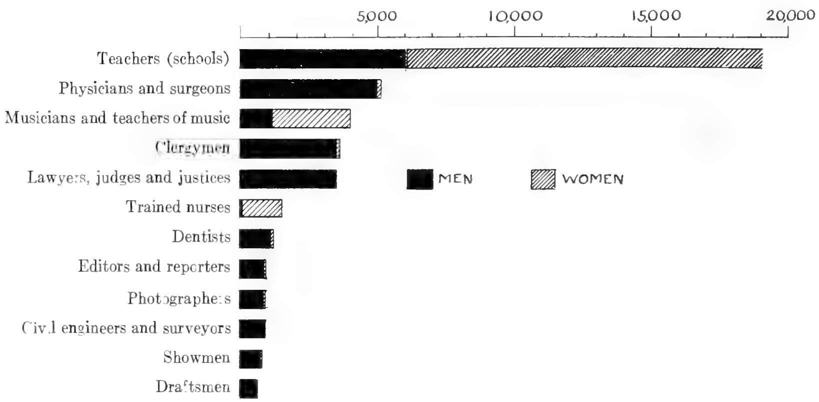
Professional pursuits with number of males and females engaged in each are as indicated in the table and pictured in Graph 15.

	Males	Females	Total
Teachers (school)	5,792	13,109	18,901
Physicians and surgeons	5,049	228	5,277
Musicians and music teachers	1,220	2,864	4,084
Clergymen	3,679	51	3,730
Lawyers, judges, and justices	3,594	17	3,611
Trained nurses	96	1,516	1,612
Dentists	1,174	36	1,210
Editors and reporters	841	158	999
Photographers	807	150	957
Civil engineers and surveyors	934	......	934
Showmen	765	43	808
Draftsmen	711	3	714
Veterinary surgeons	637	......	637
Artists, sculptors, and teachers of art	288	337	625
Attendants and helpers	378	227	605
Actors	320	239	559
Religious and charity workers	172	225	397
Other professional pursuits	138	261	399
Theater owners, managers, and officials (semiskilled)	345	16	361
College presidents and professors	328	33	361
Chemists, assayers, and metallurgists	298	15	313
Architects	299	5	304
Abstractors, notaries, and justices of peace (semiskilled)	250	34	284
Officials of lodges, societies, etc. (semiskilled)	188	68	256
Keepers of charity and penal institutions (semiskilled)	125	60	185
Healers (except physicians and surgeons)	57	90	147

	Males	Females	Total
Other occupations	112	8	120
Designers	88	23	111
Fortune tellers, hypnotists, spiritualists, etc.	11	62	73
Authors	31	32	63
Teachers (athletic, dancing, etc.)	49	12	61
Inventors	43	......	43
Mining engineers	36	......	36
Total	28,855	19,922	48,777

GRAPH 15

Workers in Professional Pursuits



§2. Specific Work of Various Age Groups

The professional pursuits of the various age groups of males and females are indicated in Table 35.

TABLE 35. SPECIFIC PROFESSIONAL PURSUITS OF EACH AGE GROUP—MALES AND FEMALES

Pursuits.	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
	Age Groups—Males.						
Teachers (school)				553	4,591	648	5,792
Physicians and surgeons				5	2,660	2,384	5,049
Musicians and teachers of music		2	18	166	832	202	1,220
Clergymen				23	1,937	1,719	3,679
Lawyers, judges, and justices				8	1,950	1,636	3,594
Dentists				6	902	266	1,174
Editors and reporters			1	55	551	234	841
Photographers			5	37	538	227	807
Civil engineers			1	44	699	190	934
Showmen		5	13	99	526	122	765
Draughtsmen				129	524	58	711
Veterinary surgeons				13	367	257	637
Six other pursuits	3,652						
Total	3,652	7	38	1,138	16,077	7,943	28,855
	Age Groups—Females						
Teachers (school)				1,778	10,185	1,146	13,109
Physicians and surgeons				3	120	105	228
Musicians and teachers of music		4	31	678	1,911	240	2,864
Trained nurses				152	1,182	182	1,516
Artists and art teachers				35	236	66	337
Attendants and helpers		1	8	89	115	14	227
Actors		5	12	62	150	10	239
Religious and charity workers				9	162	54	225
Six other pursuits	1,277						
Total	1,277	10	51	2,806	13,961	1,817	19,922

CHAPTER IX

CLERICAL PURSUITS

§1. Specific Clerical Pursuits

In Indiana in 1910, 38,570 workers were employed in the clerical pursuits; 23,671 males and 14,899 females. These pursuits ranked seventh in importance on the basis of the number of wage-earners, the percentage of the total number of all workers being 3.7.

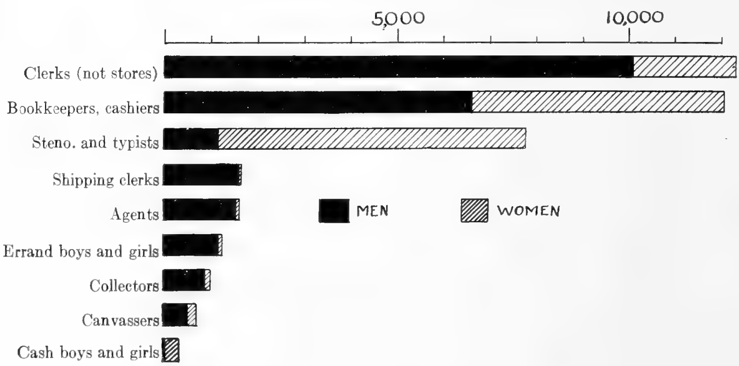
The clerical pursuits comprised the following:

	Males	Females	Total
Clerks (not in stores)	10,146	2,247	12,393
Bookkeepers, cashiers, and accountants	6,752	5,345	12,097
Stenographers and typewriters	1,093	6,639	7,732
Shipping clerks	1,577	37	1,614
Agents	1,542	70	1,612
Messengers, errand boys and girls	1,206	65	1,271
Collectors	870	90	960
Canvassers	423	236	659
Bundle and cash boys and girls	62	170	232
Total	23,671	14,899	38,570

Graph 16 shows the distribution of workers in these pursuits.

GRAPH 16

Workers in Clerical Pursuits



§2. Specific Work of Various Age Groups

The specific clerical work of various age groups for males and females is enumerated in Table 36.

TABLE 36. SPECIFIC CLERICAL PURSUITS OF EACH AGE GROUP—MALES AND FEMALES

Pursuits.	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
	Age Groups—Males.						
Clerks and shipping-clerks		4	177	2,342	7,566	1,634	11,723
Bookkeepers, cashiers, and accountants			22	977	4,759	994	6,752
Stenographers and typewriters			6	378	664	45	1,093
Agents and canvassers		1	16	120	1,208	620	1,965
Messengers, bundle and office boys		144	621	437	51	15	1,268
Collectors			13	151	516	190	870
Grand Total		149	855	4,405	14,764	3,498	23,671
	Age Groups—Females.						
Clerks and shipping-clerks		3	59	755	1,346	121	2,284
Bookkeepers, cashiers, and accountants		2	37	1,315	3,834	157	5,345
Stenographers and typewriters			61	2,174	4,334	70	6,639
Agents, canvassers, and collectors			3	47	210	136	396
Messengers, bundle and office girls		3	130	79	21	2	235
Grand Total		8	290	4,370	9,745	486	14,899

CHAPTER X

EXTRACTION OF MINERALS

§1. Specific Mining Pursuits

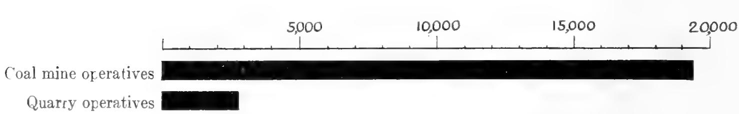
In 1910 in Indiana 24,300 persons were engaged in the extraction of minerals, 24,293 being males and 7 females. Mining, on the basis of the number of workers, ranked eighth, these workers comprising 2.3 per cent of the total.

Mining pursuits in Indiana are indicated in Graph 17 and the following table:

	Males	Females	Total
Coal mine operatives	19,184	3	19,187
Quarry operatives	2,914	2	2,916
Oil and gas well operatives	938	......	938
Foremen and overseers	489	......	489
Operators	436	1	437
Managers	215	1	216
All other mine operatives	32	......	32
Officials	22	......	22
Operators (gold and silver)	22	......	22
Inspectors	15	......	15
Iron mine operatives	14	......	14
Load and zinc mine operatives	5	......	5
Copper mine operatives	4	......	4
Salt well and works operatives	3	......	3
Total	24,293	7	24,300

GRAPH 17

Workers in Mining Pursuits



§2. Specific Work of Various Age Groups

Miners were distributed in the various age groups as indicated in Table 37.

TABLE 37. SPECIFIC MINING PURSUITS OF EACH AGE GROUP—MALES AND FEMALES

PURSUITS.	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
	AGE GROUPS—MALES.						
Coal mine operatives		20	491	2,616	12,397	3,660	19,184
Thirteen other mining pursuits	5,029	8	66	589	3,269	1,097	5,029
Grand Total	5,029	28	557	3,205	15,666	4,757	24,293
	AGE GROUPS—FEMALES.						
Four pursuits not specified	7						

CHAPTER XI

PUBLIC SERVICE PURSUITS

§1. Specific Pursuits

In Indiana in 1910, 10,368 persons were engaged in public service pursuits, 10,028 being males and 340 females. On the basis of the number of wage-earners, these pursuits ranked last in importance, the percentage of the total being 1.0 per cent.

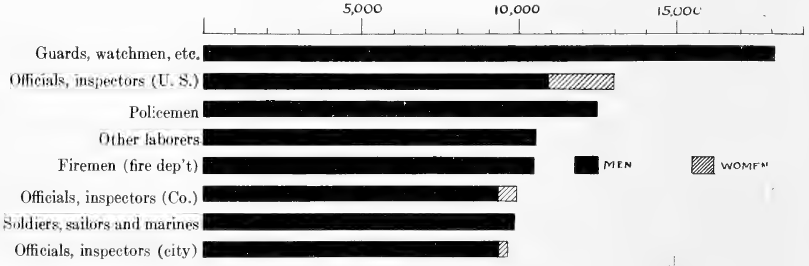
The public service pursuits were as follows:

	Males	Females	Total
Guards, watchmen, and doorkeepers..........	1,802	6	1,808
Officials and inspectors (U. S.)................	1,093	208	1,301
Policemen	1,255	......	1,255
Other laborers (public service)................	1,043	5	1,048
Firemen (fire department)....................	1,039	......	1,039
Officials and inspectors (county)..............	915	59	974
Soldiers, sailors, and marines..................	967	......	967
Officials and inspectors (city)................	910	33	943
Marshals and constables......................	321	......	321
Officials and inspectors (State)................	172	20	192
Sheriffs	187	......	187
Detectives	130	......	130
Other occupations	72	1	73
Garbagemen and scavengers (laborers, public service)	71	......	71
Probational and truant officers................	39	8	47
Life-savers	9	......	9
Lighthouse keepers	3	......	3
Total	10,028	340	10,368

Graph 18 shows the distribution of workers in these pursuits.

GRAPH 18

Workers in Public Service Pursuits



§2. Specific Work of Various Age Groups

The specific occupations of various age groups of males and females are indicated in Table 38.

TABLE 38. SPECIFIC PUBLIC SERVICE PURSUITS OF EACH AGE GROUP—MALES AND FEMALES

Pursuits.	Age Groups—Males.						
	Age Not Specified.	10 to 13 Years.	14 to 15 Years.	16 to 20 Years.	21 to 44 Years.	45 Years and Over.	Total.
Guards, watchmen, and doorkeepers				32	551	1,219	1,802
Officials and inspectors				17	1,571	1,502	3,090
Policemen				2	743	510	1,255
Laborers (public service)			7	54	516	537	1,114
Firemen (fire department)				10	749	280	1,039
Soldiers, sailors, and marines				148	773	46	967
Seven other pursuits	753						
Total	753		7	263	4,903	4,094	10,020
	Age Groups—Females.						
Officials and inspectors			1	27	154	46	228
Six other pursuits	112						
Total	112		1	27	154	46	340

CHAPTER XII

RELATIVE IMPORTANCE OF AGRICULTURAL AND INDUSTRIAL PURSUITS

It has been customary to consider Indiana as one of the group of Middle Western States in which agriculture was the dominant pursuit. Twenty years ago this classification was correct, but all the facts available show this to be no longer entirely true. There are fewer farms and a smaller farm acreage in Indiana now than in 1900, and a smaller per cent of the total number of workers are farmers. The value of farm property and farm products has, however, greatly increased, indicating perhaps that future agriculture expansion will result from more intensive rather than extensive development. On the other hand, during the same period the number of manufacturing establishments has greatly increased, the capital invested in manufacturing has greatly increased, there is now a greater percentage of the total number of workers in industry than ever before, and the value of manufactured products now far exceeds former values. Also in the last two decades there has been a marked growth in the urban population.

As a background for this section it is essential to recall the fact that in 1890 only 26 of every 100 people in Indiana lived in urban communities, increasing to 34 in 1900 and 43 in 1910. In all probability in 1914 one-half of all residents in the State are living in cities and towns. The urban gain from 1900 to 1910 was 267,541, or 30.5 per cent. During this period the rural loss was 83,127, or 5.1 per cent.

§1. Comparative Number of Workers in Agriculture and Industry

Considering the number of workers in agriculture and industry, changes no less significant have been taking place. In 1880, 52.2 per cent of all the workers in Indiana were farmers; in 1890, 46 per cent; in 1900, 39 per cent, and in 1910, 32.2 per cent, showing direct and continued decrease in percentage of agricultural workers. In industry, however, in 1880, 17.2 per cent of all were so engaged; in 1890, 20.5 per cent; in 1900, 29.9 per cent, and in 1910, 32.2* per cent, showing a direct and continued increase in

*Includes mining in 1910, as in the previous years, 1880 to 1910, mining was listed in the census under the manufacturing and mechanical group.

the percentage of industrial workers. Thus, in 1910, 334,702 persons or 32.2+ per cent of all workers were in manufacturing and mechanical pursuits and 334,454 persons, or 32.2 per cent, in agricultural pursuits. The occupational facts for 1914 would doubtless indicate a larger number in industry than in agriculture.

Table 39 contains the number and percentage of workers in these and Graph 19 pictures these same facts.

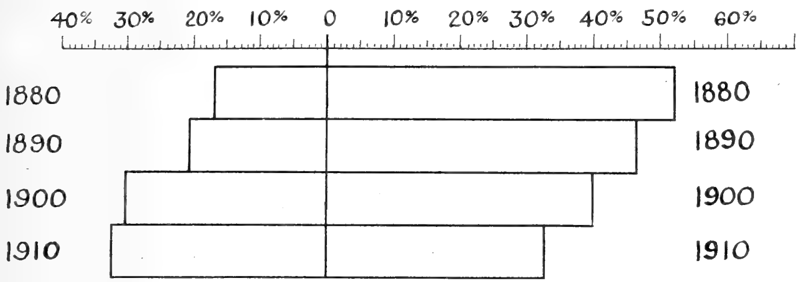
TABLE 39. NUMBER AND PER CENT ENGAGED IN AGRICULTURAL AND MANUFACTURING PURSUITS, 1880 TO 1910

	1910.		1900.		1890.		1880.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
All occupations...	1,036,710	100.0	898,953	100.0	744,303	100.0	635,080	100.0
Agriculture......	344,454	33.2	342,733	39.2	342,474	46.0	331,783	52.2
Manufacturing and mechanical	334,702	*32.2	206,611	29.9	152,825	20.5	109,518	17.2

*Includes extraction of minerals.

GRAPH 19

Percentage of Workers in Manufacturing and Agricultural Pursuits. 1880-1910



In connection with these facts the question immediately arises as to the increase in the total number of workers in all fields during this period, or, in other words, the relative and absolute increase in working population. Table 40 supplies this information together with the number and percentage of increase of workers in agriculture and industry. Graph 20 illustrates these facts.

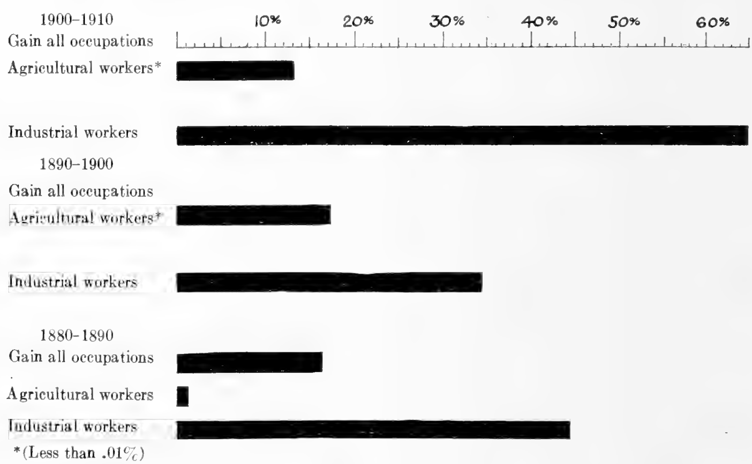
TABLE 40. NUMBER AND PERCENTAGE OF INCREASE OF WORKERS IN ALL OCCUPATIONS, COMPARED WITH NUMBER AND PERCENTAGE OF INCREASE IN AGRICULTURAL AND MANUFACTURING AND MECHANICAL PURSUITS, 1880 TO 1910

	1900 to 1910.		1890 to 1900.		1880 to 1890.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
All occupations	137,757	13.	154,650	17.	119,223	16.
Agriculture	11,701	†	247	†	10,691	1.
Manufacturing*	134,091	64.	52,786	34.	44,304	44.

*Includes mining.
†Less than .01.

GRAPH 20

Percentage Increase of Numbers of Workers in Agriculture and Industry. 1880-1910



§2. **New Workers Entering Industry**

Table 41 shows the relative proportion of industrial workers and farmers of the total increased number of workers in Indiana from 1880 to 1910. Of each 100 of the increased number of workers from 1880 to 1890, 9 were farmers, and 37 industrial workers; from 1890 to 1910, .1 were farmers and 34 were industrial workers, and from 1900 to 1910, 1 was a farmer and 97 industrial workers. Graph 21 pictures these facts.

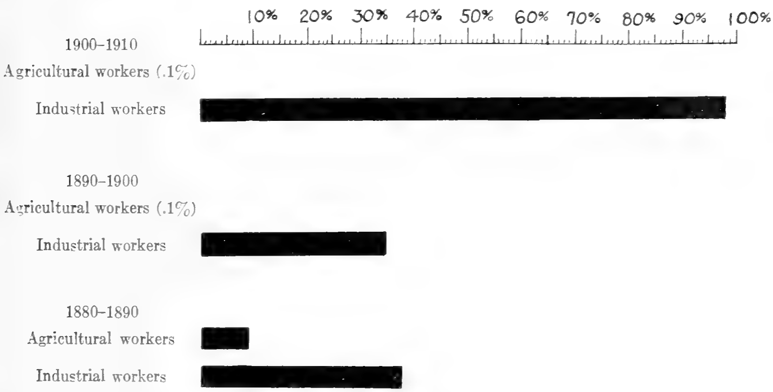
TABLE 41. PROPORTION OF NEW WORKERS IN INDIANA, FROM 1880 TO 1910, WHO WERE FARMERS AND INDUSTRIAL WORKERS

	1900 to 1910.	1890 to 1900.	1880 to 1890.
	Per Cent.	Per Cent.	Per Cent.
Agricultural workers...........	1.	*	9.
Industrial workers.............	97.	34.	37.

*Less than .01 per cent.

GRAPH 21

Percentage of New Workers Entering Agricultural or Industrial Pursuits. 1880-1910



§3. Decrease in Farms and Farm Acreage

Considering farms and farm acreage, it has been noted under the section on "Agriculture" that in 1910 there were 6,412 fewer farms in Indiana than in 1900, and 519,800 fewer acres of farm land, representing a loss of 2.9 per cent in farms and 1.5 per cent in acreage. Comparing this with the number of manufacturing establishments in Indiana from 1899 to 1909, we note a gain of 740, or 15 per cent. These facts are contained in Table 42.

TABLE 42. LOSS IN NUMBER OF FARMS AND FARM ACREAGE AND GAIN IN NUMBER OF MANUFACTURING ESTABLISHMENTS, INDIANA, 1900 TO 1910

Census.	Farms.			Farm Acreage.			Manufacturing Establishments.		
	Number.	Loss.		Number.	Loss.		Number.	Gain.	
		Number.	Per Cent.		Number.	Per Cent.		Number.	Per Cent.
1910........	215,485	6,412	2.9	21,299,823	519,800	1.5	7,969	841	11.6
1900........	221,897			21,819,623			7,128		

§4. Comparative Value of Agricultural and Manufacturing Products

The estimated value of farm products and manufactured products affords another measure of the relative importance of agriculture and industry in Indiana. Farm products include all crops, live stock, dairy products, etc., whether sold or consumed. The value of manufactured products, however, includes only articles made within manufacturing establishments, and the figures recorded do not include the value added to raw materials as a result of the work of the plumber, carpenter, plasterer, electrician, etc., save as these pursuits are incident to the products manufactured within factories.

On the basis enumerated in 1899, manufactured products were worth, expressed in thousands, $337,072, while agricultural products were worth only $204,450, or about 59 per cent as much. In 1909 manufactured products were worth $579,075 and agricultural products $239,849, or 58 per cent as much. From 1899 to 1909 the increase in the value of agricultural products was 66.2 per cent, while during this period the increase in the value of manufactured products was 71.8 per cent. These facts are contained in Table 43.

TABLE 43. VALUE OF FARM AND MANUFACTURED PRODUCTS AND INCREASE IN VALUE OF THESE PRODUCTS, 1899 TO 1909

Census.	Farm Products.			Manufactured Products.		
	Value.	Gain.		Value.	Gain.	
		Amount.*	Per Cent.		Amount.*	Per Cent.
1909........	$239,849			$579,075		
		$135,399	66.2		$242,003	71.8
1899........	$204,450			$337,072		

*Expressed in thousands.

§5. Value of Farm Property

From 1900 to 1910 the value of farm land, buildings, implements, domestic animals, poultry, and bees increased 84.9 per cent. This in part represents the increase in capital invested in agriculture. From 1899 to 1909 the capital invested in manufacturing increased 131.9 per cent. The value of farm property in 1910, however, was three times as great as the capital invested in manufacturing. These facts are given in Table 44.

TABLE 44

	Value of Farm Property.			Capital Invested in Manufacturing			
	Value.	Gain.			Value.	Gain.	
		Amount.	Per Cent.			Amount.	Per Cent.
1910.	$1,809,135,238			1909	$508,717,000		
		$830,518,767	84.9			$289,396,000	131.9
1900.	$987,616,471			1899	$219,321,000		

§6. Industry Now as Important as Agriculture

In summarizing, all of the evidence presented points conclusively to the fact that while from every standpoint the agricultural pursuits are tremendously important, the manufacturing and industrial pursuits are now equally as important and in many respects more so.

Industrial pursuits, including mining, in 1910 engaged the time of more workers than did the agricultural pursuits. Since 1880 there has been practically no gain in the number of agricultural workers in Indiana, while the number of industrial workers has increased enormously, being 64 per cent from 1900 to 1910, as compared with a per cent less than .01 in agriculture for the same period. Of all the new workers in Indiana from 1900 to 1910, 97 of each 100 were in the industries and one in the agricultural pursuits.

The number of farms has decreased, as has also farm acreage, while the number of manufacturing establishments has increased continually.

The value of agricultural as well as manufactured products has increased considerably from 1900 to 1910, but the greater increase has been in the manufactured products. Since 1899 the products of agriculture have been worth but 58 per cent of the value of the products of industry.

The great increase in manufacturing cannot be due to the so-called "natural gas boom," as the greatest growth has occurred between the years 1900-1910. Natural gas may have been responsible for the beginning of the great industrial development, but it is thought that the resources of the State, the railroad facilities, and the proximity of centers of population are the real and

basic factors conditioning this development. Such being the case, the future will doubtless witness a much greater industrial expansion.

In the words of the census:

In 1849 Indiana ranked fourteenth among the States of the Union in the value of its manufactures, the total value of the products being $18,725,000. Each decade since then has shown a large increase, the value of the manufactured products of the State reaching the $100,000,000 mark in 1869, while in 1909 it amounted to $579,075,000, and the State ranked ninth in this respect. The growth has been dependent largely upon the natural resources of the State, consisting of an abundant supply of timber, important agricultural products, and a large production of petroleum and natural gas. During the past decade the supply of timber, petroleum, and natural gas has fallen off greatly, and some of the industries depending upon these materials show a decrease in their output or less advance than in previous years. The manufacturing industries of the State as a whole, however, have continued to flourish, lumber having been secured from outside the State to supplant the local supply, while the increasing amount of coal mined in the State has compensated manufacturing in many lines.*

*Vol. 9, pp. 303, United States Census, 1910.

CHAPTER XIII

DEDUCTIONS RELATIVE TO EDUCATION

PART I. RELATIVE TO THE POPULATION AND GENERAL EDUCATION

§1. **Widely Distributed Responsibilities for General and Vocational Education**

With 42 per cent of the entire population of Indiana distributed among one city over 100,000 inhabitants, four cities between 25,000 and 100,000, 20 cities between 10,000 and 25,000, 26 cities between 5,000 and 10,000, 37 towns between 2,500 and 5,000, and 57.6 per cent of the population in rural districts, it is readily seen that the people are very widely and comparatively evenly distributed in residence over the State. The responsibilities for all types of education are thus widely distributed and practically no district in the State is exempt from this duty.

For purposes of general education, Indiana is committed to the permanent policy of making adequate provision for meeting the educational needs resulting from this wide distribution in place of residence by establishing and maintaining rural township consolidated, town, and city schools.

For the purposes of vocational education this wide distribution of population presents a much more difficult problem, more difficult in degree than in most of the States thus far committed to a system of State-aided vocational schools. As the situation in Indiana is somewhat unique, it is particularly necessary that all the possible factors should be carefully considered before deciding upon definite and permanent state policies.

§2. **Illiteracy in the Entire Population**

As a State, illiteracy, averaging all classes of the population, has been reduced from 4.6 per cent in 1900 to 3.1 per cent in 1910. This shows great educational progress. In spite of this reduction, however, in 1910 there were ten States in the Union having a smaller percentage of illiteracy. Considering Indiana's wealth and educational facilities and the relatively small percentage of foreign born living in this State, it is thought that the

percentage of illiteracy is far too high. The illiterate population is relatively evenly distributed over the entire State and thus constitutes a problem for all school districts in Indiana.

§3. Stability of Population

The population of Indiana is fairly stable although up to 1910 the facts show that a considerable number of those born in Indiana have moved to other States, and that a considerable number now residing in Indiana were born in other States. However, comparing Indiana with some of the Eastern and Western States, the population may be regarded as relatively stable. This fact very greatly simplifies the whole educational problem.

§4. Education for Native White Residents

With 94.1 per cent of the entire population of Indiana in 1910 being native born whites, the schools are facing the problem of educating a native born population. Although illiteracy among native whites in the State was reduced from 3.6 per cent in 1900 to 2.1 per cent in 1910, there were, in 1910, twenty-nine States with a smaller percentage of illiteracy among the native white residents. This points definitely to the need for more vigorous enforcement of compulsory school education laws and perhaps to a need in some sections for extended educational facilities.

§5. Education for Colored Residents

Although in 1910 there were but 60,320 colored residents in the State, comprising 2.2 per cent of the entire population, the number is sufficiently large to justify serious educational consideration, particularly in view of the fact of the high percentage of illiteracy among them. From 1900 to 1910 the percentage of illiteracy was reduced from 22.6 per cent to 13.7 per cent, showing marked educational progress. However, as most of the negroes in Indiana are born within the State, a direct need for a stricter enforcement of the compulsory education laws is shown.

§6. Education for Foreign Born Residents

The problem of education for the foreign born coming to Indiana is one of increasing importance and difficulty each year. Although but 5.9 per cent of the total population of Indiana were foreign born in 1910 and but 5.6 per cent in 1900, the percentage of illiteracy increased during the decade from 11.4 per cent to

11.7 per cent. It is thought that this increase was not due primarily to any increased inefficiency on the part of the schools, but rather to the increased number of foreigners coming to the State from the southwestern European countries. Attention has previously been called to the facts showing the shift in the tide of immigration to Indiana from Northwestern to Southwestern Europe.

Concerning the residence of foreign born whites in Indiana, the facts show that they are living in cities in the proportion of about three of every four, and also that a considerable number of these foreign born are living in the cities and towns of the northwestern section of the State.

To safeguard the stability of the State and make possible a high type of citizenship among the foreign born, schools and employers of labor must coöperate in eliminating illiteracy and ignorance. To this end, every possible facility should be provided; night schools, factory classes and schools, and part-time classes. The State cannot afford to pay the price incident to general ignorance of the English language and a knowledge of the economic and social and personal ideals of our country.

PART II. RELATIVE TO INDUSTRIAL ARTS FOR ELEMENTARY SCHOOLS

§1. Elementary Period and Fundamentals Concerning Course of Study

In keeping with what is considered as the best educational theory and practice of the day, the elementary period is here considered as comprising grades one to six, inclusive. The following factors are considered as basically fundamental for courses of study for this period: First, the principal content of elementary courses should be the same the country over, regardless of place, either State, city, or town. There must be uniformity in the fundamental content, but variety in methods of approach, emphasis of various units in the course and in time devoted to sections of the course. This unity is essential to insure the retention of common ideals, purposes, etc., and the variety within the bounds suggested, in making provision for teaching children of various nationalities, various degrees of natural capacity, etc. Second, in the main, this elementary course should center about those facts which should be taught to all children regardless of sex, future vocation; facts usually conceded to be essential to all people in all fields of productive activity. Third, as a unit of subject-

matter in this course, a study of the primal industries must be included and the interpretation must be broad enough and the content rich enough to secure the breadth of industrial intelligence necessary for good citizenship and a rudimentary understanding of our day and its problems. The course in elementary industrial art should include information and participation in the following fields: food, clothing, wood, metal, clay and earth products.

§2. Industrial Art in Elementary Grades

The question immediately arises, Are these primal industrial pursuits present in Indiana and distributed throughout the State so as to afford the children an apperceptive basis for their study and opportunities for making such studies vital and real by first-hand observation of the materials, processes, and people engaged in them? The facts show that the primal industrial pursuits are carried on in Indiana and distributed through the State in places of all sizes and types.

An enumeration of some of the specific pursuits of each of the primal industries is here made to indicate the great variety of occupational pursuits and thus the richness of the background for courses in Elementary Industrial Art.

In the field of food production and manufacturing the following pursuits are carried on: food production—farming, dairying, fruit growing, stock and poultry raising, etc. In the field of food manufacture and preserving—baking, slaughtering, meat-packing, milling, fruit and vegetable canning, sugar refining, and the manufacture of butter and cheese.

In the field of textile and clothing manufacturing: in textile manufacturing—cotton and woolen goods in great variety; in clothing manufacturing—shoes, men's and women's hats, suits, coats, dresses, underwear, etc.

In the field of wood industries and pursuits: wood industries—manufacturing furniture, refrigerators, carriages, wagons, agricultural implements, piano and organ cases, barrels, etc. In wood pursuits—carpentering, woodcarving, wheelwrighting, sawmilling, etc.

In the field of the metal industries and pursuits: metal industries — manufacturing iron and steel, surgical instruments, cutlery, railroad cars and car parts, tin and enamelware, automobiles, sewing-machines, etc.; metal pursuits—work of machinists, blacksmiths, tin and coppersmiths, moulders, founders, casters, polishers, grinders, etc.

In the field of clay and allied earth products: clay and earth products—manufacture of lime, cement, brick, tile, terra cotta, pottery and glass, and in the mining of gypsum, marble and stone; and the pursuits—glass blowing, stone quarrying and cutting, etc.

With the presence of these primal pursuits in Indiana and the diversity of occupations among them, and the wide distribution of these pursuits over the State, there are few physical obstacles in the way of environmental opportunity conditioning and making difficult the teaching of rich, well-rounded courses in industrial art. But few States in the Union present such a rich background for the introduction of industrial art courses. To continue manual training courses comprising, in the main, paper and yarn weaving, basketry, and exercises in wood in the elementary schools, is to fail to take advantage of the wonderful opportunities within the State for developing industrial intelligence and appreciation by a study of the primal industrial pursuits within the State.

PART III. CONTENT OF COURSES FOR PRE-VOCATIONAL PERIOD FOR GRAMMAR AND HIGH SCHOOLS, JUNIOR HIGH SCHOOLS, ETC., BASED ON OCCUPATIONAL FACTS

§1. **Fundamental Assumptions**

It is assumed that one of the functions of schools and courses for pupils in the pre-vocational period (roughly comprising grades 7, 8, 9 as schools are now organized) is to provide a considerable range of activities and experiences so as to furnish opportunities for all types of minds and also to assist pupils in determining interests and capacities, so that future education will yield larger results in terms of directness and purposefulness.

It is also assumed that another function equally important for schools and courses of this period is to provide opportunities for specialized technical training for over-age boys and girls and for those who are likely to leave the schools soon and directly enter wage-earning pursuits.

§2. **Local Surveys and Courses of Study**

The question concerning the type courses which should be introduced into such schools has given rise to discussion and debate throughout the country. It is probably the concensus of opinion at the present time that a local school cannot be sure of the proper courses to introduce till exhaustive local surveys have been made. In keeping with this belief many cities and towns in dif-

ferent parts of the country have been so "surveyed." It is contended by the writer that local surveys cannot answer the question as to the type courses needed in the pre-vocational period because education in this period cannot be assumed to be for fitting the particular pupils of the community for the local pursuits carried on in the community at the time such surveys were made, considering the local community to be bounded by the corporate limits of the city, town, or school district.

Interpreting the term "community" as being bounded by the horizon of the pupil and his parents, then there is more justification for stating that pre-vocational courses must be adapted to community needs. Dr. Ayres* has shown that of the fathers living in seventy-eight cities only one in six is now living in the city in which he was born, and that of the boys only a little more than one-half are living in the city of their birth. Another conditioning factor is that the existence of an industry or a pursuit or a type of industries or pursuits in a community today does not insure its or their presence twenty years from today. We know further that if the local pursuits are limited in variety, that the pupils' interests, capacities, and potentialities will represent a greater range of distribution than the occupational opportunities for employment within the community. There are sufficient facts to justify the statement that, though local surveys are important, such surveys cannot condition and prescribe in the final analysis the proper types of courses for schools of the pre-vocational period. State surveys will yield more dependable data, and a national survey would be even more satisfactory. Herein lies the value of Dr. Ayres' study of *Constant and Variable Occupations*,* for it attempts to show the pursuits common to all communities and those largely localized in particular sections.

Considering the fact that up to 1910 about 74 per cent of the people born in Indiana were still living in Indiana, and that the pursuits of Indiana are in the main not very different from those found in the States to which the 26 per cent have migrated, it is safe to conclude that the lines of pursuits found within the State of Indiana constitute a safe and sane basis for courses in pre-vocational schools.

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*Leonard P. Ayres, *Some Conditions Affecting Problems of Industrial Education in Seventy-eight American School Systems.* Russell Sage Foundation, N. Y.

†Leonard P. Ayres, *Constant and Variable Occupations and Their Bearing on Problems of Vocational Education.* Russell Sage Foundation, New York.

§3. General Facts Concerning Courses, Based on Occupational Statistics of Indiana

Though it is of primal importance to make adequate provision for the education of those who will complete the high school and college and enter the professions, it is not this group with which our data are most concerned, and for which these educational deductions are intended. Our interest in this study is centered about those who will enter the pursuits of agriculture, industry, commerce, and domestic and personal service.

It is not within the province of this study to project ideals relative to the organization of schools. However, in passing, it might be said that a great injustice will be done individuals and society if special pre-vocational schools are established for industrial, commercial, and domestic education for normal pupils. The establishment of such schools presupposes that pupils have made vocational choices and are directly preparing for wage-earning pursuits. To assume that a child 13 or 14 years of age is capable of making an intelligent vocational choice is fallacious. On the other hand, as previously stated, a great injustice will be done over-age pupils and those about to leave school to go to work, if some provision for considerable technical training is not made. A safe and sane ideal to project, and the only feasible one for most of the towns in Indiana, is that of a school under one roof, containing many departments, each open to all under sane elective standards, standards permitting considerable shifting among courses and between departments. Thus each shall know the work of all and each gain a variety of experiences. A graduate of any department of such a school should be permitted to enter, unreservedly, the next higher school. In the same school, however, provision for specialization for over-age boys and girls and for those about to go to work should be made.

In keeping with the group occupational pursuits in Indiana, these five general types of courses should be provided: agricultural; industrial, including mining; commercial, including trade; transportation and clerical; household and domestic and personal service; and professional service.

§4. Courses for Boys

No attempt is here made to enumerate or even list the general courses for boys or girls or the courses related to the units of instruction here proposed.

Agricultural Courses

Since the agricultural pursuits in Indiana include general farming, gardening, dairying, fruit-growing, stock-raising, and forestry, the fundamentals in these lines should be included in courses of study together with other lines which give promise of increasing the agricultural productivity of the State.

Industrial Courses

In view of the occupational facts, the traditional manual training courses in exercises in wood will have to give way to a study and participation in the dominant lines of industry represented in the State. The dominant pursuits adapted to school instruction comprise the building trades with the following lines: carpentry, painting, masonry, plumbing, and plastering; the metal trades, including machine operating and work of machinists, blacksmiths, sheet metal workers, forgers, casters, etc.; the wood industries, including machine operating, wheelwrighting, furniture-making, carriage-making, etc.; electrical work especially looking toward electrical engineering; printing and publishing, including foundry work, composition and press work; and clothing industries, particularly tailoring.

It is not to be assumed that a school in a small city must include all of the above lines; any of them will be far more useful than the traditional manual training courses. It is thought that the minimum should be three of the suggested lines, but in cities of the 50,000 class and over all could be included at least in type.

Many of the dominant industrial pursuits in Indiana are not included in this list, some because they are thought not to be adapted to school procedure, and others because they are largely unskilled. The manufacture of iron and steel and saw-milling are not adapted to schoolroom procedure and the percentage of unskilled is too high in the following pursuits to justify school training: confectionery, leather and rubber, textiles, cigar and tobacco, chemical pursuits, and paper and pulp industries.

Commercial Courses

The clerical pursuits of bookkeeping and stenography, when studied alone, are too restricted in scope to permit pupils to gain any understanding of commercial life or any preparation for future commercial study and participation. The facts show the need for courses in merchandising, buying and selling, and all the

problems incident thereto. In detail, courses should include, in the field of trade, the elements of salesmanship, wholesaling and retailing, importing and exporting, work of insurance agents, express agents, etc.; in the field of transportation, telegraph operating, etc.; and in the field of clerical pursuits, bookkeeping and stenography, collecting, work of shipping-clerks, etc.

§5. Courses for Girls

It is assumed that in the pre-vocational period it is the duty of the school to provide the greatest possible range of type courses for girls as well as for boys. The courses for girls should aim to assist them in discovering aptitudes and capacities and interests with a view to more direct and specific vocational training in later years and for preparation for wage-earning for those who must leave school to enter wage-earning pursuits.

One of the surest methods of making self-realization possible and exploitation impossible is to provide the training necessary for economic independence. This ideal is not at all incompatible with that of meeting and successfully solving the problem of home-making. The facts show that, for the State of Indiana as a whole, of the young women between the ages of 16 and 20, 270 of each 1,000 were at work. This is an average of country, village, town, and city, and, therefore, the number at work in cities is much higher, being in Indianapolis about 530 of each 1,000. For the country as a whole, the average for these years is almost 40 per cent.

The question may be asked, Why insist that the possibility of vocational training be provided for all girls when but about one-half the young women in cities are at work? In reply it may be said that it is impossible to know what girls are to constitute the female working population. Changes in the financial position of the head of the family or a sudden death or illness or personal choice force many girls and women into wage-earning pursuits.

The occupational facts for Indiana indicate that in this period courses for girls should include the elements of agriculture, industry, commerce, household and domestic and personal service pursuits, aside from those leading to the professions.

Agricultural Courses

These phases of agricultural education should be provided: gardening and greenhouse working, dairying, and poultry-raising.

Industrial Courses

The industrial pursuits which should be provided are: manufacturing of clothing, including dressmaking, millinery, and tailoring; printing and publishing, including composing, proofreading, bookbinding, etc. Many other industrial pursuits are open to women in Indiana, but as they are largely unskilled, it is not thought wise to include them among proposed courses. Among these unskilled pursuits in which women are engaged in considerable numbers are candy-making, baking, cigar and cigarette making, textile manufacturing, glass-making, various iron and steel pursuits, as well as a variety of wood pursuits.

Commercial Courses

The principal commercial lines open to women are selling (clerks and salesladies), bookkeeping, stenography, and typing. Courses in these fields should be provided. Telephone operating is also open to women, but the training of such operators is usually provided by telephone corporations.

Household, Domestic, and Personal Service Courses

Over 80 per cent of women employed in these pursuits in Indiana are servants, cooks, chambermaids, or laundresses. It is held that before schools are justified in training for these occupations, and particularly for servants and laundresses, that more should be known as to hours of work, conditions under which work is performed, wages, etc.

The work under this head is not to be confused with homemaking courses, which are, of course, held to be essential for all young women. As the census gives no facts or figures concerning work of housewives and the problem of homemaking, no statements are here made concerning this most important field.

Professional Courses

Aside from teaching, courses for women should be given looking toward nursing, photography, designing, architecture, and social work.

*PART IV. CONTENT OF COURSES FOR VOCATIONAL SCHOOLS: DAY, PART TIME, AND CONTINUATION**

§1. Local Surveys and Courses of Study

While the presence of an occupational pursuit in a local community may not be the final measure in determining whether or not vocational courses preparing for the pursuit shall be introduced into the local schools, from an administrative and teaching standpoint it is much more economical to localize vocational courses where the pursuits are fundamentally important. Thus, since there are large and permanent printing and publishing interests in Hammond, day vocational courses in printing would here be more easily taught and yield larger net returns than in Muncie. Part-time and continuation courses in printing might also be needed at Hammond, but the probability is that such needs would not exist in Muncie.

The position is here taken that before establishing vocational courses, day, part-time, or continuation,* communities must first ascertain the extent and scope and importance of the various occupational pursuits. The occupational facts contained in this study will be useful in this connection in showing the State-wide extent of local pursuits.

§2. Courses for Day Vocational Schools

The facts advanced in the previous section concerning the necessity for data showing the extent and scope of local occupational pursuits apply with directness in the consideration of courses for day vocational schools. On the other hand, are there no pursuits constant throughout the State for which courses might be established without making local occupational surveys? The courses which are thought to be needed in nearly all cities in Indiana are specified in outline form under the section concerning pre-vocational courses in the fields of industry, commerce, and domestic and personal service. The question, however, as to whether day vocational courses and part-time courses or continuation courses will best meet the needs of workers entering these pursuits is, in the main, a local problem. The Richmond survey has answered the question in a number of fields, but there is still little definite knowledge concerning a great number of pursuits. In order to have positive assurance that day vocational courses are vitally needed and will directly function, occupations

*Day or evening general or vocational.

must be analyzed in terms of knowledge and skill required, and what the pursuit does or does not offer in terms of training for workers and also what the school could profitably offer.

§3. Courses for Part-Time Vocational Schools

Under the provision of the Indiana Vocational Education Law, local boards are authorized to require the attendance upon part-time classes of all youths, gainfully employed, between the ages of 14 to 16, in the pursuits for which part-time education is given. The need for such part-time classes is obvious, but the extent of the need is realized by but few. In Indiana in 1910 there were 28,678 boys and 6,005 girls under 16 years of age profitably employed. Although the compulsory school laws have been modified since 1910, in all probability at the present time about 35,000 boys and girls in Indiana under 16 are now profitably employed.

What type of part-time education shall be provided? According to the law, part-time education, to receive special State aid, must be complementary to the practical work of the profitable employment. It is, therefore, first necessary for communities to ascertain the pursuits in which youths from 14 to 16 are engaged, and, second, to attempt to work out some plan whereby the part-time education may contribute to the success of the youths in their daily pursuits in terms of intelligence and efficiency, promotions, and increased wages.

For this type of vocational part-time education the law has made provision; and, in those pursuits where youths are apprenticed or where lines of promotion are clearly defined, such part-time education will be constructively helpful. If this type of part-time education, for which the law provides State aid, is to be helpful to large numbers of boys and girls under 16, the occupational pursuits open to youths must be so organized as to contain factors for which the schools can train.

A careful study of the tables herein contained, indicating the specific pursuits of boys and girls under 16 years of age shows the approximate numbers for whom part-time vocational education would be possible. For all those under 16 engaged in the agricultural pursuits complementary part-time education is possible. This would include about 21,000, the great majority being boys. During the winter months such boys could attend school two or three afternoons each week, and receive instruction in agriculture, which would give meaning and practical help to the work in which they are engaged during the remainder of the year.

Of the 12,500 boys and girls under 16 who are engaged in all pursuits other than agriculture, about 4,000 are engaged in work for which part-time vocational education of the trade extension type could be provided, and about 9,500 in pursuits for which no part-time vocational education of the trade extension type is at all possible or necessary. For the latter, the general continuation school is needed, which aims to provide a type of general and prevocational education assisting them to discover aptitudes and lines of employment more promising than those in which they are engaged.

For the 600 youths under 16 employed as general laborers in the building trades, what type of part-time education can be organized to be directly complementary to this work? For the 200 girls under 16 rolling cigarettes and cigars, what type of school education can be complementary to this profitable employment? For the 1,000 bundle and messenger boys and girls, what complementary education could be proposed? For the 125 female telephone operators under 16, what part-time complementary education is possible?

The obvious need for about 75 per cent of the boys and girls who are profitably employed and under 16 years of age, aside from those employed on farms, is for general part-time education. The State Vocational Department has recognized this vital need,* and it is to be hoped that superintendents and employers may coöperate in establishing such part-time classes, and that at an early date special State aid may be provided for this most fundamental educational obligation.

PART V. THE NEED OF OCCUPATIONAL SURVEYS AND ANALYSES

§1. The Limitations of the Census Data

During the course of this study the writer carefully reviewed all publications containing any phase of occupational information for Indiana. The United States census was found to be the only source of information at all adequate and reliable. The census report concerning "Occupations" was not published till the spring of 1914, and contains facts derived four years previous. Further, the occupational data are given only for the State as a whole and for places of over 25,000 inhabitants. At best, the occupational facts in the census are but rough preliminary measures. No occupational studies in terms of knowledge and skill required, etc., are included in this report.

*See Bulletin Vocational Series 4, Department of Public Instruction, State of Indiana, pp. 24, 25, W. F. Book.

§2. Local Occupational Surveys

The necessity for local communities knowing the extent of the presence of various occupational pursuits for purposes of vocational education has been fully demonstrated in previous sections. It is impossible for most Indiana cities to engage "survey experts" to gather these facts. If such information is to be obtained for the cities of Indiana, it must be gathered by those within the school systems. A simple method must be derived so that teachers and principals may efficiently study their own cities and determine for themselves the local needs. Two or three occupational surveys must be made in Indiana with a view of establishing a method of procedure which will be simple and accurate. The necessary information will concern age, sex, nationality, and occupational distribution of workers, and the education and educational deficiencies of workers.

§3. Occupational Analyses.

The necessity for occupational studies has been established. In Indiana such studies are vitally needed in mining, in stone quarrying, in slaughtering and meat-packing, in the chemical industries, in the manufacture of sewing-machines, automobiles, railroad and street cars and car parts, surgical instruments and cutlery, and carriages and agricultural implements.

Vol. XII, No. 18 INDIANA UNIVERSITY BULLETIN March 1, 1915

INDIANA UNIVERSITY STUDIES

27. ARITHMETIC: A COÖPERATIVE STUDY IN EDUCATIONAL MEASUREMENTS. By M. E. Haggerty, Associate Professor of Psychology, Director of the Psychological Laboratory, and Director of the Bureau of Coöperative Research, Indiana University.

For Sale by the University Bookstore, Bloomington, Ind. Price 50 Cents

The 'University Studies' constitute a sub-series of the Indiana University Bulletin, *in which from time to time are published some of the contributions to knowledge made by instructors and advanced students of the University. At present not more than three or four issues are published a year. The 'Studies' are continuously paged and numbered, and, as needed, a title-page and table of contents will be issued, for binding them up in volumes.*

For sale by the University Bookstore, Bloomington, Ind.

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Indiana University Studies

No. 27 BLOOMINGTON, INDIANA March 1, 1915

Introduction

The investigation which is here reported is the outcome of two requests which reached the psychological laboratory of Indiana University at about the same time, in the autumn of 1913. One came from Mr. S. A. Courtis, requesting that the laboratory undertake to be a clearing-house for the Courtis Standard Tests in Indiana. The other came from a committee of the Indiana City Superintendents' Research Club for coöperation in educational research. As a result, twenty of the cities represented in the research club gave the Courtis tests in arithmetic in May, 1914, and sent to the laboratory the tabulated results. These results were worked up in comparative studies and more than seventy charts were prepared and used in presenting the data to the meeting of the club at Wabash, Indiana, on October 28, 1914. These charts, which presented the essential facts in a detailed way, were then routed by the secretary of the club and sent to each of the cities which had participated in the investigation. Each city was permitted to use the charts three days. By request, the club voted permission to the University to publish the results in bulletin form.

Credit for this bulletin is due to the several hundred teachers who gave the tests and computed the individual and class scores, to the administrative officers who supervised the giving of the tests and arranged the class and school records for the University, and to the superintendents who have courageously undertaken to measure by scientific methods the results of their work.

A number of persons have assisted in arranging the data in comparative tables and in making the necessary mathematical computations. Mr. Paul Mort corrected most of the class and school record sheets, and computed many of the city and individual medians and variabilities. He also rendered great assistance with the graphs, making the original charts which were sent to the several cities. Miss Glenora Swadener assisted in making the distribution tables and the tabulations under the questionnaire. As-

sistance was rendered in many ways by Miss Cecile White, Fellow in Philosophy, by Mr. C. C. Stech, Fellow in Education, and by Mr. Earl Moore, Technical Assistant in the Psychological Laboratory. Valuable advice and service have been given also by Professors H. L. Smith and H. G. Childs, of the School of Education.

This coöperative endeavor marks a new movement in the progress of education in Indiana. Growing out of this investigation has come the suggestion for a permanent Bureau of Coöperative Research connected with the University. At a recent meeting the Board of Trustees authorized the formation of such a bureau, the details of which were set forth in a recent *University News-Letter* (Vol. II, No. 12).

In the discussion which follows, little more is attempted than to point out the salient facts shown by the tables and graphs. The possible causes for high or low scores are numerous and complex, and can hardly be deciphered from the data at hand. In Part II an attempt is made to study two of the causes—namely, the time of beginning, and the amount of time spent on the subject. If results from the use of standardized tests continue to accumulate, we should be able to evaluate numerous other conditions affecting the psychology of learning.

Contents

"THE time has now come when opinions, traditions, and rule-of-thumb methods should yield to a science of education. . . . . If we could only realize what it would mean to have a science of education, a science of health, a science of conduct, surely all the resources of our civilization would be turned in this direction."—J. MCKEEN CATTELL.

Arithmetic: A Coöperative Study in Educational Measurements

By M. E. Haggerty, Associate Professor of Psychology, Director of the Psychological Laboratory, and Director of the Bureau of Coöperative Research, Indiana University.

PART I

A COMPARATIVE STUDY OF TWENTY INDIANA CITIES

Tests and Methods

All of the cities gave the Courtis Standard Test, Arithmetic, Series B. Some gave Test 7 in Series A, but for several reasons the results of the latter are not included in this study. In the case of Series B, the tests were given as directed, the individual scores were computed, the results were transferred to score sheet No. 1, the median and per cent of variability were computed on this sheet, and these two items were then transferred to score sheet No. 3. All of the above work was done by the teaching corps of the several cities. All of the material—individual score sheets, record sheets No. 1 and record sheets No. 3—were then sent to the University. These records were then rechecked to see whether the work had been properly done. The general method was as follows: Sample individual score sheets were taken at random from each city. If these proved to be correctly done it was assumed that the class distributions on record sheet No. 1 were correct. If these individual score sheets were in error they were corrected and new distributions were made out. After this, the computations of medians and variabilities were verified and record sheets No. 3 were corrected. Owing to a rather general misunderstanding of some of the methods used the amount of corrective work was considerable; the compensation is the fund of highly dependable data here presented.

CITIES COÖPERATING

The list of cities coöperating in these tests is as follows:

Alexandria.	Hartford City.
Anderson.	Kendallville.
Bluffton.	Laporte.
Columbia City.	Michigan City.
Crawfordsville.	Mount Vernon.
Crown Point.	Noblesville.
Decatur.	Plymouth.
Elwood.	Princeton.
East Chicago.	Rochester.
Frankfort.	Wabash.

Total number of children reported, 8,712.

In the tables, charts, and discussions which follow, these cities are indicated by numbers. The order is not alphabetical. Each city reported the children of four school grades, four tests to each grade. The results of each test are figured for the number of problems attempted (speed) and the number correctly solved (accuracy). This gives *thirty-two* measures of each school system. Further, the per cent of variability and per cent of dependability are computed.

RESULTS: TABLES

In order that the reader may have a fair view of all the results, they will first be presented in the form of distribution tables. Table I is for the number of problems *attempted* in the fifth grade in Test 1 (addition). It reads across as follows: In city 1, there are in the fifth grade: 1 child who attempted 1 problem, 2 children who attempted 2 problems, 7 children who attempted 3 problems, and so on across the table; the total number of children taking the test being 156, the median 7.2, and the per cent of variability 25. Inasmuch as the number of children in the several cities differs widely a direct comparison is difficult. The tables have, therefore, been reduced to a per cent basis. Since the total number of children is given in each case it is easy to find the number making each score by multiplying the total number by the per cent in the score required.

Table II represents the same facts shown in Table I and reads: In city 1, .6 per cent of the children attempted 1 problem, 1.3 per cent of the children attempted 2 problems, and so on across the table, the total number of children being 156, the median attempts being 7.2, and the per cent of variability being 25. The mode in each case is in bold face type. Tables II to XXXIII contain all the data resulting from these tests.

City Distributions—Fifth Grade—Addition: Attempts. Number of Children Making Each Score

CITY	Score. 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	....	1	2	7	15	19	26	**34**	20	18	7	4	....	....	2	....	....	....	1	....	....	....	....	....	....	....	156	7.2	25	**1**
2	....	....	8	9	18	16	**25**	11	5	2	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	95	5.8	29	**2**
3	....	....	4	8	40	57	**68**	54	40	17	9	1	3	2	3	1	....	....	....	....	....	....	....	....	....	....	307	6.7	27	**3**
4	....	2	5	11	19	18	**24**	7	3	3	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	93	5.5	30	**4**
5	....	1	7	7	**23**	10	14	2	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	68	4.8	33	**5**
6	....	2	4	11	30	36	**58**	40	48	10	12	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	255	6.8	27	**6**
7	....	....	....	2	7	6	**14**	6	3	3	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	42	6.4	24	**7**
8	....	....	1	1	6	7	**21**	17	14	12	1	3	2	....	2	....	....	....	....	....	....	....	....	....	....	....	87	7.5	25	**8**
9	....	....	5	17	40	43	**47**	24	17	6	7	6	1	1	1	....	....	....	....	....	....	....	....	....	....	....	215	6.1	29	**9**
10	....	1	....	8	14	25	34	**41**	36	18	12	5	3	....	2	....	....	....	....	....	....	....	....	....	....	....	199	7.4	24	**10**
11	....	1	2	5	11	18	24	**29**	24	4	9	2	....	1	....	....	....	....	....	....	....	....	....	....	....	....	130	7.0	25	**11**
12	....	....	3	4	17	19	**32**	17	16	7	5	2	1	....	1	....	....	....	....	....	....	....	....	....	....	....	124	5.3	27	**12**
13	....	....	....	1	10	6	16	**19**	**19**	8	7	4	2	....	....	....	....	....	....	....	....	....	....	....	....	....	92	7.6	24	**13**
14	....	....	2	5	20	25	**42**	21	9	6	2	....	1	1	....	....	....	1	....	....	....	....	....	....	....	....	135	6.4	25	**14**
15	....	....	2	8	23	38	**45**	42	31	11	7	2	1	1	....	....	....	....	....	....	....	....	....	....	....	....	211	6.8	24	**15**
16	....	....	....	4	16	10	**15**	13	13	7	2	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	81	5.7	26	**16**
17	....	....	....	4	8	12	11	10	**18**	9	11	2	2	2	....	....	2	....	....	....	....	....	....	....	....	....	91	7.6	29	**17**
18	....	....	1	2	3	6	**11**	6	9	3	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42	6.8	27	**18**
19	1	....	3	8	19	28	**30**	20	21	5	....	3	1	1	....	1	....	....	....	....	....	....	....	....	....	....	141	6.0	28	**19**
20	....	....	3	9	2	12	**13**	**13**	5	2	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	60	6.4	26	**20**
Total..	1	9	54	134	345	412	**562**	426	355	141	92	40	20	9	11	2	2	1	1	....	....	....	....	....	....	....	2,624	6.6	28	

TABLE II

City Distributions—Fifth Grade—Addition: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1		.6	1.3	4.5	9.62	12.2	16.7	**21.8**	12.8	11.5	4.5	2.6			1.3				.6								156	7.2	25	**1**
2			8.4	9.5	18.9	16.8	**26.3**	11.7	5.3	2.1			1.														95	5.8	29	**2**
3			1.3	2.6	13.	18.5	**22.1**	17.6	13.	5.5	2.9	.3	.9	.6	.9	.3											307	6.7	27	**3**
4			2.1	5.4	11.9	20.4	18.2	**25.8**	7.5	3.2	3.2			1.													93	5.5	30	**4**
5		1.5	10.3	10.3	33.8	14.7	**20.6**	2.9	5.9																		68	4.8	33	**5**
6		.8	1.6	4.3	11.8	14.1	**22.8**	15.7	18.8	3.9	4.7	1.6															255	6.8	27	**6**
7				4.8	16.7	14.3	**33.3**	14.3	7.3	7.3			2.4														42	6.4	24	**7**
8			1.1	1.1	6.9	8.	**24.1**	19.5	16.1	13.8	1.1	3.4	2.3		2.3												87	7.5	25	**8**
9			2.3	7.9	11.1	18.6	20.	**21.9**	7.9	2.8	3.2	2.7	.5	.5	.5												215	6.1	29	**9**
10		.5		4.	7.	12.5	17.	**20.1**	18.	9.	6.	2.5	1.5		.1												199	7.4	24	**10**
11		.8	1.5	3.8	8.5	13.8	18.5	**22.3**	18.5	3.	6.9	1.5		.8													130	7.	25	**11**
12			2.4	3.2	8.9	15.3	**25.8**	8.9	12.9	5.6	4.	1.6	.9		.9												124	5.3	27	**12**
13				1.	10.9	6.5	17.4	**20.6**	**20.6**	8.7	7.6	4.3	2.2														92	7.6	24	**13**
14			1.5	3.7	14.8	18.5	**31.1**	15.5	6.7	4.4	1.5		.7	.7				.7									135	6.4	25	**14**
15			.9	3.8	10.9	18.	**21.3**	19.9	14.7	5.2	3.3	.9	.5	.5													211	6.8	24	**15**
16				4.9	19.8	12.4	18.5	16.	16.	8.6	2.5	1.2															81	5.7	26	**16**
17				4.4	8.8	13.2	12.	11.	**19.8**	9.9	12.	2.2	2.2	2.2			2.2										91	7.6	29	**17**
18			2.4	4.8	7.1	14.3	**26.2**	14.3	21.4	7.1		2.4															42	6.8	27	**18**
19	.7		2.1	5.7	13.5	19.9	**21.3**	14.2	14.9	3.5		2.1	.7	.7		.7											141	6.	28	**19**
20			5.	1.5	3.3	20.	**21.7**	**21.7**	8.3	3.3	1.7																60	6.4	26	**20**
Total..	.04	.35	2.07	5.15	13.3	16.5	**21.6**	16.9	13.8	5.4	3.7	1.56	.78	.35	.43	.08	.08	.04	.04								2,624	6.6	28	

TABLE III

City Distributions—Fifth Grade—Addition: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	9.6	14.1	**15.4**	14.7	14.7	8.3	10.9	8.3	1.9	.6	.6					.6											156	3.8	56	**1**
2	**20.**	15.8	**20.**	12.6	10.5	12.6	3.2	2.1	3.2																		95	2.7	78	**2**
3	5.5	10.7	13.7	15.3	**17.9**	12.	12.	5.9	3.9	1.3		.3	.6	.6													307	4.3	51	**3**
4	2.1	12.9	**26.9**	21.5	18.3	7.5	5.4	3.2	1.	1.																	93	3.4	48	**4**
5	14.7	**22.**	17.6	19.1	14.7	7.3	2.9	1.5																			68	2.7	59	**5**
6	7.9	8.7	17.3	15.7	**21.3**	10.2	7.9	7.9	.8	1.6	.8																254	4.	52	**6**
7	14.2	19.	9.5	**21.4**	11.9	4.8	14.3	2.4	2.4																		42	2.9	80	**7**
8	16.	18.4	**19.6**	13.8	11.5	5.8	1.1	6.9	4.6	1.1	1.1																87	2.9	75	**8**
9	16.7	16.7	**19.**	13.	10.7	9.8	4.7	2.8	1.9	2.3	1.4	.9															215	3.	73	**9**
10	6.5	10.6	**17.**	**17.**	14.	10.5	11.6	6.5	3.	.5	1.5	1.															199	3.9	74	**10**
11	6.1	13.	**20.**	11.5	16.9	13.	8.5	4.6	4.6	1.5																	130	4.	57	**11**
12	8.9	**25.8**	12.9	16.1	12.	8.9	4.8	5.7	3.2	.8		.8															124	3.2	66	**12**
13	1.	8.7	14.1	15.2	15.2	**16.3**	5.4	10.9	9.8	2.1		1.															92	4.9	45	**13**
14	8.1	15.5	**24.4**	13.3	14.	12.6	8.1	1.5		.7			.7		.7												135	3.4	56	**14**
15	6.6	14.2	**17.5**	15.6	15.1	14.2	9.	3.8	1.9	.9	.5		.5														211	3.7	55	**15**
16	**24.7**	16.	12.3	12.3	14.8	7.4	6.1	4.9	1.2																		81	2.8	82	**16**
17	3.3	5.5	**19.8**	6.6	9.9	12.	14.3	8.8	6.6	5.5	4.4	2.2	1.1														91	5.3	53	**17**
18	7.1	14.3	**16.7**	**16.7**	11.9	**16.7**	9.5	2.4	2.4			2.4															42	3.7	59	**18**
19	14.2	9.9	**21.3**	13.4	14.9	17.7	4.9	2.1		.7	.7																141	3.6	54	**19**
20	1.7	10.	16.7	**25.**	16.7	13.3	6.6	5.	3.3		1.7																60	4.1	41	**20**
Total..	9.3	13.42	**17.61**	15.05	15.02	11.3	7.97	5.16	2.63	1.18	.65	.38	.19	.08	.04	.04											2,623	3.6	58	

TABLE IV

City Distributions—Fifth Grade—Subtraction: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	....	....	1.9	1.9	4.5	7.7	**18.7**	14.2	15.5	9.7	12.9	4.5	4.5	1.3	1.9	....	....	....	.6	....	....	....	....	....	....	....	155	8.1	24	**1**
2	....	....	....	2.1	11.6	15.8	**25.3**	18.9	15.8	6.3	1.	2.1	1.	....	....	....	....	....	....	....	....	....	....	....	....	....	95	6.8	25	**2**
3	....	....	.6	1.3	3.6	7.1	**27.4**	18.9	17.6	14.3	5.5	1.3	.6	1.3	.3	....	....	....	....	....	....	....	....	....	....	....	307	7.5	23	**3**
4	....	....	1.	4.3	13.9	19.4	**32.3**	13.9	11.8	3.2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	93	6.4	25	**4**
5	....	1.5	6.	**12.**	**21.2**	16.7	19.7	13.7	6.	3.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	66	5.5	33	**5**
6	....	....	.8	1.5	5.5	7.	**23.6**	17.3	22.8	11.8	3.9	3.1	1.5	....	.8	....	....	....	....	....	....	....	....	....	....	....	254	7.7	23	**6**
7	....	....	....	2.4	9.5	11.9	**26.2**	16.7	9.5	9.5	9.5	4.8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42	7.4	21	**7**
8	....	....	1.2	1.2	....	9.3	22.	17.4	**29.**	8.1	3.5	....	4.6	1.2	1.2	1.2	....	....	....	....	....	....	....	....	....	....	86	7.8	21	**8**
9	....	....	2.3	4.1	12.	13.9	**21.4**	19.	12.	9.8	2.3	1.8	.5	....	....	.5	....	....	....	....	....	....	....	....	....	....	215	6.7	25	**9**
10	....	....	....	1.5	4.5	11.5	**20.6**	12.5	19.1	11.	12.5	3.5	2.	1.	....	....	....	....	....	....	....	....	....	....	....	....	199	8.	24	**10**
11	.8	....	.8	1.5	6.9	9.2	**26.9**	26.1	11.5	5.3	6.1	3.8	.7	....	....	....	....	....	....	....	....	....	....	....	....	....	130	7.1	22	**11**
12	....	....	1.6	2.4	7.2	7.2	**25.8**	20.1	13.7	11.3	6.4	3.2	.8	....	....	....	....	....	....	....	....	....	....	....	....	....	124	7.3	24	**12**
13	....	....	....	....	2.2	5.4	11.9	17.4	**23.9**	15.2	13.	5.4	4.3	1.	....	....	....	....	....	....	....	....	....	....	....	....	92	8.7	20	**13**
14	....	....	.7	2.1	3.5	12.9	**25.2**	17.9	15.1	12.2	6.5	3.6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	139	7.7	25	**14**
15	.5	....	.5	2.3	5.6	8.	**22.2**	21.2	20.7	10.8	2.3	3.3	.9	.9	....	....	.5	....	....	....	....	....	....	....	....	....	212	7.5	22	**15**
16	....	....	1.3	2.5	16.4	22.8	**26.6**	17.7	8.9	....	3.8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	79	6.3	25	**16**
17	....	1.1	2.2	1.1	6.6	8.8	19.8	**22.**	13.1	8.8	5.5	4.4	3.3	2.2	....	1.1	....	....	....	....	....	....	....	....	....	....	91	7.6	26	**17**
18	....	....	....	....	9.5	4.7	16.6	7.1	**28.6**	14.3	9.5	2.4	4.8	....	2.4	....	....	....	....	....	....	....	....	....	....	....	42	8.2	24	**18**
19	....	....	1.4	.7	2.8	9.9	19.8	22.	**24.8**	7.	5.6	3.5	2.1	....	....	....	....	....	....	....	....	....	....	....	....	....	141	7.8	20	**19**
20	....	....	....	3.3	8.3	23.3	**28.3**	15.	13.3	5.	1.7	....	....	....	....	1.7	....	....	....	....	....	....	....	....	....	....	60	6.7	24	**20**
Total..	.08	.08	1.07	2.21	6.8	10.7	**23.**	18.1	17.4	9.78	6.03	2.68	1.49	.53	.3	.15	.04	....	.04	....	....	....	....	....	....	....	2,622	7.3	25	

TABLE V

City Distributions—Fifth Grade—Subtraction: Rights. Per Cent of Children Making Each Score

CITY	Score																										Total Number of Children	Median Score	Per Cent Variability	CITY
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25				
1	9.7	4.5	8.4	7.7	11.	**16.1**	11.6	12.3	6.5	5.2	3.9	1.9	.6	....	....	.6	....	....	....	....	....	....	....	....	....	....	155	5.4	49	**1**
2	12.6	9.5	13.7	15.7	**16.8**	10.5	9.5	5.3	4.2	1.1	1.1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	95	3.9	56	**2**
3	5.5	3.9	8.1	9.1	11.4	19.2	**20.0**	10.4	6.2	3.3	2.6	.3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	307	5.6	36	**3**
4	5.1	10.1	14.1	15.2	**16.1**	15.2	11.1	11.1	2.0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	99	4.2	44	**4**
5	9.1	7.6	18.2	**19.7**	13.6	13.6	15.2	1.5	1.5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	66	3.8	27	**5**
6	5.5	10.2	7.5	5.5	14.2	**15.7**	15.0	7.9	10.6	3.9	2.4	.8	....	....	.8	....	....	....	....	....	....	....	....	....	....	....	254	5.5	48	**6**
7	4.8	9.5	11.9	9.5	14.3	**16.6**	9.5	14.3	2.4	4.8	2.4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42	5.	43	**7**
8	9.3	7.0	8.1	10.5	18.5	**22.0**	11.6	7.0	....	2.4	....	1.2	1.2	1.2	....	....	....	....	....	....	....	....	....	....	....	....	86	4.8	48	**8**
9	**16.4**	12.6	9.8	14.5	15.9	8.3	7.0	7.0	4.6	3.4	....	.5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	215	3.6	70	**9**
10	4.0	6.5	6.5	9.0	**16.2**	12.1	14.1	16.1	7.5	4.5	2.5	1.0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	199	5.7	40	**10**
11	3.8	7.7	8.5	10.1	12.3	**19.1**	15.4	10.8	6.9	3.1	1.5	.8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	130	5.3	41	**11**
12	4.0	4.8	11.3	11.3	15.3	13.7	**16.2**	7.3	10.5	4.0	.8	.8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	124	5.3	46	**12**
13	2.2	2.2	3.3	9.8	10.9	**18.5**	12.9	**18.5**	9.8	5.4	5.4	1.1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	92	6.3	33	**13**
14	3.7	6.7	10.4	11.9	17.0	**13.3**	10.4	11.1	8.1	5.9	1.5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	135	5.3	42	**14**
15	4.7	8.5	6.1	15.5	**19.4**	13.7	12.3	7.5	6.6	3.3	.9	....	.5	.5	.5	....	....	....	....	....	....	....	....	....	....	....	212	4.8	42	**15**
16	12.7	7.6	12.7	18.9	**21.6**	10.1	10.1	2.5	2.5	1.3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	79	3.9	49	**16**
17	3.3	9.9	4.4	9.9	8.8	**14.3**	11.0	14.2	8.8	4.4	5.5	1.1	2.2	1.1	1.1	....	....	....	....	....	....	....	....	....	....	....	91	6.3	44	**17**
18	4.8	9.5	14.2	4.8	11.9	**16.6**	14.3	14.3	4.8	....	2.4	2.4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42	5.3	45	**18**
19	3.5	10.6	13.5	12.1	13.5	**14.1**	13.5	12.1	5.0	.7	.7	.7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	141	5.4	51	**19**
20	3.3	6.7	11.7	5.0	25.0	**26.6**	6.7	13.3	1.7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	60	5.	36	**20**
Total..	6.52	7.7	9.27	11.0	14.7	**15.**	13.4	10.	6.29	3.24	1.75	.61	.19	.12	.16	.04	....	....	....	....	....	....	....	....	....	....	2,624	5.	46	

TABLE VI

City Distributions—Fifth Grade—Multiplication: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	.6	.6	3.2	10.3	9.0	14.1	15.3	**16.7**	12.2	4.5	4.5	5.1	1.3	2.6	....	....	....	....	....	....	....	....	....	....	....	....	156	6.8	32	**1**
2	....	....	4.2	19.2	**24.4**	**24.4**	9.6	9.6	2.2	3.2	3.2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	94	5.1	35	**2**
3	....	.3	.7	3.4	8.8	21.9	**31.6**	16.9	8.9	4.7	2.4	.3	1.	....	....	....	....	....	....	....	....	....	....	....	....	....	307	6.5	23	**3**
4	....	2.2	2.2	10.7	21.5	**24.7**	21.5	11.8	3.2	2.2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	93	5.5	29	**4**
5	2.8	8.8	7.4	14.7	**25.**	22.1	5.8	7.5	4.4	....	....	1.5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	68	4.6	37	**5**
6	....	....	3.1	11.8	4.7	18.9	**27.7**	18.1	10.2	3.1	1.6	....	.8	....	....	....	....	....	....	....	....	....	....	....	....	....	254	6.5	26	**6**
7	....	....	....	....	9.5	11.9	**26.2**	7.1	17.6	7.1	11.8	2.3	2.3	....	2.3	....	....	....	....	....	....	....	....	....	....	....	42	7.4	30	**7**
8	....	....	1.2	5.8	4.6	15.1	**30.2**	20.9	8.1	3.5	7.	1.2	....	....	....	1.2	....	....	....	....	....	....	....	....	....	....	86	6.9	23	**8**
9	1.8	6.	10.6	16.1	12.9	**17.2**	13.8	11.5	5.5	1.8	1.8	....	1.	....	....	....	....	....	....	....	....	....	....	....	....	....	217	5.1	37	**9**
10	....	.5	1.4	6.0	4.0	14.1	**19.1**	15.1	16.4	11.1	6.	3.4	1.0	.5	....	1.0	....	....	....	....	....	....	....	....	....	....	199	7.3	27	**10**
11	.7	....	2.9	14.5	13.8	13.8	**23.9**	15.9	8.7	2.9	1.5	.7	....	.7	....	....	....	....	....	....	....	....	....	....	....	....	138	6.	29	**11**
12	....	.8	4.	8.1	13.7	8.9	18.5	**19.4**	9.7	7.3	2.4	4.	2.4	....	.8	....	....	....	....	....	....	....	....	....	....	....	124	6.7	30	**12**
13	....	1.1	....	1.1	4.3	6.5	17.2	**21.5**	16.1	11.8	11.8	4.3	3.2	1.1	....	....	....	....	....	....	....	....	....	....	....	....	93	7.9	24	**13**
14	....	.7	4.4	8.2	9.6	17.8	18.5	**21.5**	10.4	3.7	3.	1.5	....	.7	....	....	....	....	....	....	....	....	....	....	....	....	135	6.4	25	**14**
15	.5	.9	3.4	16.5	9.4	17.0	**20.2**	17.0	9.0	2.8	1.9	1.4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	212	6.1	31	**15**
16	....	1.3	5.2	5.1	21.8	**23.0**	17.9	7.7	11.5	3.9	2.6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	78	5.7	30	**16**
17	....	1.1	2.3	5.6	6.6	**21.9**	18.6	13.2	9.8	6.6	8.8	4.4	1.1	....	....	....	....	....	....	....	....	....	....	....	....	....	91	6.9	29	**17**
18	....	....	2.4	7.1	7.1	14.4	**19.0**	**19.0**	9.5	4.8	9.5	2.4	4.8	....	....	....	....	....	....	....	....	....	....	....	....	....	42	7.	30	**18**
19	1.4	....	1.4	5.0	18.5	22.0	**23.4**	12.8	7.8	3.5	2.8	.7	.7	....	....	....	....	....	....	....	....	....	....	....	....	....	141	6.2	22	**19**
20	....	....	....	5.0	10.0	21.7	23.3	**26.7**	5.0	5.0	....	3.3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	60	6.5	25	**20**
Total..	.42	1.18	3.19	9.32	10.92	17.68	**21.11**	15.86	9.44	4.56	3.42	1.6	.94	.31	.076	.12	....	....	....	....	....	....	....	....	....	....	2,630	6.3	30	

TABLE VII

City Distributions—Fifth Grade—Multiplication: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	16.1	13.5	9.0	**17.2**	12.2	11.5	6.4	5.8	3.2	1.9	2.6	.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	156	3.8	66	**1**
2	16.8	**24.1**	19.	17.8	9.5	7.4	3.2	...	1.1	...	1.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	95	2.5	68	**2**
3	3.4	5.2	10.4	17.7	**23.2**	17.7	12.2	5.5	3.4	1.0	.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	307	4.6	39	**3**
4	3.2	13.9	**21.4**	17.1	17.2	17.2	4.3	2.1	2.1	1.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	93	3.6	53	**4**
5	**23.6**	13.2	20.6	14.7	14.7	8.8	2.9	...	...	1.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	68	2.6	77	**5**
6	10.2	12.6	9.5	13.4	**22.7**	14.2	11.	2.4	1.6	1.6	...	.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	254	4.1	49	**6**
7	11.9	**16.6**	9.6	9.6	14.2	11.9	11.9	9.5	...	2.4	...	2.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	42	3.9	64	**7**
8	10.5	9.3	15.1	**17.4**	13.9	15.1	13.9	1.2	1.2	1.2	1.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	86	4.2	51	**8**
9	**27.5**	13.4	13.9	14.4	9.8	11.6	4.2	2.8	1.9	...	...	.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	215	2.7	67	**9**
10	5.6	10.1	15.0	14.0	11.5	**17.0**	13.0	7.1	4.5	1.1	1.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	199	4.5	51	**10**
11	13.1	10.8	9.2	**22.3**	13.1	17.6	6.2	5.4	...	1.5	.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	130	3.8	57	**11**
12	11.3	10.5	11.3	12.1	14.5	**17.7**	7.3	7.3	.8	5.6	.8	.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	124	4.4	58	**12**
13	2.2	4.3	8.6	7.5	12.9	**15.**	18.2	12.9	9.7	6.5	...	2.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	93	5.9	38	**13**
14	11.1	8.9	11.0	**20.6**	20.0	11.8	7.4	3.0	4.5	.8	.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	135	3.9	53	**14**
15	13.2	12.7	**19.8**	16.5	15.1	10.0	7.5	3.3	1.4	.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	212	3.3	60	**15**
16	16.7	19.2	8.9	**20.4**	14.2	8.9	6.5	3.9	1.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	78	3.3	67	**16**
17	8.8	4.4	8.8	13.2	9.9	**18.6**	11.0	7.7	8.8	4.4	3.3	1.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	91	5.	48	**17**
18	11.9	9.6	**19.0**	7.2	14.1	**19.0**	7.2	4.8	2.4	2.4	2.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	42	4.2	57	**18**
19	11.2	15.7	15.7	15.7	**19.8**	6.4	9.2	2.1	3.5	.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	141	3.8	46	**19**
20	3.3	11.7	20.1	8.3	15.0	**24.9**	11.7	3.3	1.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	60	4.5	48	**20**
Total	11.45	11.48	13.24	15.57	**15.8**	13.97	8.93	4.39	2.75	1.49	.61	.34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2,621	3.9	56	

TABLE VIII

City Distributions—Fifth Grade—Division: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	4.5	3.2	13.5	**17.9**	**17.9**	7.	5.8	8.3	6.4	3.9	4.5	2.6	1.3	1.3	1.9												156	4.9	51	**1**
2	5.2	4.2	15.8	24.2	**27.3**	3.2	6.3	2.1	6.3		2.1		1.1			1.1								1.1			94	4.	45	**2**
3	.3	2.6	5.8	19.5	**21.3**	11.4	9.7	14.1	6.5	3.6	3.6	1.	.3			.3											307	5.6	39	**3**
4		8.7	21.5	21.5	**23.6**	5.4	5.4	6.4	3.2	2.1	1.1			1.1													93	4.	45	**4**
5	2.9	16.2	19.1	**23.6**	22.1	5.9	2.9	4.4	2.9																		68	3.5	46	**5**
6	3.9	6.3	14.9	**29.1**	18.	7.9	5.6	7.9	5.6		.8																254	3.9	45	**6**
7	4.9	9.8		24.4	**26.8**	2.4	9.8	12.2	2.4	7.3																	41	4.5	42	**7**
8	1.2	1.2	2.4	17.7	**18.8**	**18.8**	8.2	10.6	3.5	.7	.7	2.4				1.2											85	4.8	36	**8**
9	5.2	10.7	15.8	**23.6**	20.8	7.	5.2	5.2	3.7	1.9	.9																215	3.7	47	**9**
10		4.1	5.5	18.5	**19.6**	18.5	9.1	9.1	8.1	2.5	2.	1.	.5		.5		.5	.5									199	5.1	40	**10**
11	3.1	5.3	13.1	19.3	**23.8**	8.5	6.2	6.9	6.9	3.1	1.5	1.5	.8														130	4.2	42	**11**
12	3.2	8.1	16.1	17.	**25.**	8.8	7.2	8.1	4.1	.8	1.6																124	4.2	45	**12**
13		1.	7.5	15.	**19.4**	11.9	9.6	14.	7.5	5.4	3.2	1.1	3.2	1.1													93	6.1	40	**13**
14	.7	8.2	8.2	**24.4**	19.2	9.6	8.2	9.6	3.7	3.	2.2	1.5		1.5													135	4.6	45	**14**
15	.5	3.3	8.	20.8	**25.**	10.4	10.4	7.6	8.9	1.4	1.4	1.4	1.														212	4.8	38	**15**
16	1.3	7.9	**23.7**	18.4	19.8	3.9	9.2	6.6	7.9	1.3																	76	3.9	44	**16**
17		2.2	9.9	17.5	**25.2**	6.6	5.6	10.9	6.6	4.4	5.6	1.1	3.3			1.1											91	5.2	41	**17**
18			7.1	19.	**21.5**	7.1	16.7	7.1	2.4	11.9	4.8	2.4															42	5.3	42	**18**
19	2.8	4.3	10.6	**20.6**	**20.6**	6.4	8.5	9.2	7.8	5.	2.1		2.1														141	4.7	41	**19**
20			13.3	**21.6**	20.	18.3	10.	8.3	1.7	1.7	1.7	1.7				1.7											60	4.8	40	**20**
Total..	2.10	5.21	11.3	21.	**21.4**	9.45	7.7	8.6	5.83	2.7	2.28	.81	6.42	.22	.19	.19	.04	.04									2,617	4.5	42	

TABLE IX

City Distributions—Fifth Grade—Division: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	**30.**	16.3	9.8	11.1	5.2	7.2	1.3	5.8	5.8	2.6	.6	2.	2.														153	2.5	90	**1**
2	**42.2**	17.9	13.7	10.6	9.5		3.2	1.				1.			1.												95	1.5	107	**2**
3	**17.3**	11.4	16.3	14.	10.1	6.8	8.5	8.1	2.6	2.6	1.	.7	.3	.3													307	3.4	68	**3**
4	7.5	18.2	**22.6**	18.3	16.1	4.3	2.1	6.5	2.2	1.1				1.1													93	3.2	55	**4**
5	**30.9**	26.5	14.7	14.7	8.8		2.9	1.5																			68	1.7	88	**5**
6	**23.6**	21.3	15.7	11.8	7.9	7.1	4.7	5.5	2.4																		254	2.5	79	**6**
7	**22.5**	7.5	20.	17.5	10.	7.5	7.5	5.	2.5																		40	3.	77	**7**
8	15.1	15.1	**18.1**	12.8	8.2	5.8	7.	5.8	5.9	1.2	1.1	2.3		1.2													86	3.7	75	**8**
9	**34.9**	24.2	13.5	9.2	6.	5.6	4.2	1.4		.5	.5																215	1.9	70	**9**
10	**23.6**	16.6	15.6	13.1	9.1	5.	6.	5.5	3.6	.5	.5	.5					.5										199	2.6	85	**10**
11	**26.9**	17.7	13.8	12.4	6.9	5.4	5.4	6.9	2.3	1.5	.8																130	2.3	69	**11**
12	22.6	**22.7**	12.9	12.2	9.7	8.1	5.6	1.6	3.2		1.6																124	2.8	74	**12**
13	7.5	15.	14.	**16.1**	5.5	14.	7.5	9.8	2.2	3.2	1.1	1.1	2.2														93	4.1	63	**13**
14	**21.5**	14.1	15.7	11.8	13.3	5.9	4.5	4.5	2.9	3.	3.																135	2.9	87	**14**
15	**21.7**	13.7	21.2	11.3	11.3	6.6	6.1	3.8	1.9	.5	.9	.5	.5														212	2.7	81	**15**
16	**36.9**	15.6	1.8	6.5	5.2	9.2	2.6	3.9		1.3																	76	1.9	84	**16**
17	**17.6**	14.3	13.2	13.1	5.6	2.9	11.	6.	3.3	4.4	3.3	1.1	3.3		1.1												91	3.9	90	**17**
18	11.9	10.	**21.3**	14.3	7.1	7.	7.	7.1	4.8	4.8	2.4	2.4															42	3.5	69	**18**
19	**21.3**	18.4	13.5	14.9	7.9	6.4	9.2	5.	2.	1.4	.7	.7															141	3.2	71	**19**
20	10.	**18.3**	**18.3**	13.3	6.7	11.7	11.7	3.3	1.6	1.7		1.7				1.7											60	3.5	75	**20**
Total..	**22.9**	17.08	15.75	12.61	8.65	6.28	5.84	5.05	2.45	1.3	.8	.54	.46	.16	.08	.04	.04										2,614	2.6	81	

TABLE X

City Distributions—Sixth Grade—Addition: Attempts Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1				2.3	5.1	3.4	11.4	15.3	**19.3**	10.8	9.7	9.	10.3	1.7	1.1	.6											176	8.5	23	**1**
2			4.41	2.94	10.3	17.6	**25.1**	16.2	11.7	5.9	2.9			1.5	1.5												68	6.6	26	**2**
3			.3	2.6	4.6	7.9	**19.6**	17.1	14.7	9.8	8.2	6.9	4.6	1.	1.	1.	.7										305	7.9	25	**3**
4			1.4	8.4	12.4	22.	**29.**	13.8	7.	2.8	1.4	1.4															72	6.2	26	**4**
5			1.6	4.8	19.1	**28.6**	15.7	11.	9.6	4.8	4.8																63	5.9	27	**5**
6			3.0	7.4	10.4	14.8	**19.3**	14.1	11.1	9.7	4.4	3.3	1.1	.7			.7										270	6.7	32	**6**
7				9.1	3.	3.	**33.4**	24.2	9.1	15.2	3.																33	7.1	22	**7**
8						4.3	15.7	17.1	14.3	15.7	**18.5**	7.2	2.9	14.1	2.9												70	8.9	22	**8**
9			1.	4.9	5.9	4.9	**20.1**	**20.1**	15.2	11.3	5.9	4.4	3.4	2.00	.5			.5									204	7.7	25	**9**
10			.5	.5	2.	7.	17.	**22.5**	21.	14.5	7.	2.	3.	1.5		1.	.5										200	8.	25	**10**
11			1.2	2.4	6.5	18.1	**20.**	17.	17.1	8.8	7.1	1.2	.6														170	7.2	25	**11**
12				1.8	11.5	13.3	**25.6**	17.6	11.5	7.9	6.2	2.7	.9			.9			.9								113	7.4	22	**12**
13					3.08	9.2	12.3	**18.5**	15.4	12.3	15.4	7.7	3.1	3.1													65	8.6	24	**13**
14			3.	3.	10.9	13.2	**22.4**	20.5	12.4	6.6	3.	2.2	.7	.7	.7							.7					137	6.9	27	**14**
15		.5	1.4	2.8	4.8	10.5	15.4	17.2	**19.1**	14.4	7.2	3.3	2.4		.5			.5									209	7.9	25	**15**
16				3.3	9.9	**21.2**	19.	19.	13.3	8.8	1.1		2.2		1.1					1.1							90	6.8	26	**16**
17					4.8	13.1	19.	**21.3**	7.2	11.9	10.7	4.8	4.8	1.2		1.2											84	7.9	24	**17**
18					15.2	24.2	12.1	6.1	**27.3**	12.1		3.															33	7.	31	**18**
19			.9	3.6	9.9	10.8	20.7	15.3	19.9	9.9	**27.**	6.3															111	7.3	27	**19**
20			1.6	4.7	6.2	6.2	**28.1**	17.2	17.2	7.8	6.3		3.1			1.6											64	7.4	28	**20**
Total		.039	1.11	3.2	7.12	11.5	**19.4**	17.4	15.1	10.3	6.52	3.84	2.4	1.	.5	.4	.2	.1	.039	.039		.039					2,530	7.4	26	

TABLE XI

City Distributions—Sixth Grade—Addition: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	3.00	5.4	11.8	10.6	**13.5**	9.5	7.8	10.1	14.1	5.9	1.2	4.7	1.8	.6	...	...	...	...	...	...	...	...	...	...	...	...	169	5.6	46	**1**
2	16.2	17.6	10.3	14.7	**19.1**	5.9	7.3	5.9	...	1.5	...	...	1.5	...	...	...	...	...	...	...	...	...	...	...	...	...	68	3.4	68	**2**
3	3.3	6.9	11.4	11.2	14.4	**14.7**	13.2	6.9	5.9	4.9	2.3	1.00	2.00	1.3	.3	.3	...	...	...	...	...	...	...	...	...	...	305	5.2	46	**3**
4	...	9.7	19.4	18.1	15.2	**19.5**	8.3	7.	2.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	72	4.2	46	**4**
5	6.3	20.7	12.6	**24.1**	15.7	3.2	1.6	1.6	1.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	63	3.9	51	**5**
6	8.1	13.4	**19.5**	18.5	14.1	7.4	3.7	8.1	3.7	.7	...	.7	1.4	...	...	.7	...	...	...	...	...	...	...	...	...	...	270	3.5	57	**6**
7	12.2	6.1	15.2	**24.1**	18.1	9.1	9.1	3.00	3.00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	3.8	47	**7**
8	7.2	12.8	12.8	**18.5**	11.5	7.2	12.8	5.8	8.6	1.4	1.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	70	3.9	63	**8**
9	6.4	11.8	12.7	12.7	11.7	13.7	15.3	5.4	3.9	2.9	1.5	.5	.5	1.00	...	...	...	...	...	...	...	...	...	...	...	...	204	4.6	51	**9**
10	2.00	8.00	**15.0**	12.0	14.0	19.5	8.00	12.0	4.00	2.00	1.00	1.5	...	1.00	...	...	...	...	...	...	...	...	...	...	...	...	200	4.9	45	**10**
11	7.7	10.1	15.5	**16.7**	11.7	13.7	11.7	6.5	2.9	2.3	1.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	169	4.1	49	**11**
12	8.00	14.1	12.3	**16.0**	17.8	11.5	7.1	5.4	.9	4.5	1.8	.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	113	5.	51	**12**
13	1.5	6.2	10.8	10.8	**15.4**	12.3	7.7	**15.4**	12.2	6.2	...	1.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	65	5.6	45	**13**
14	6.7	10.	14.1	17.1	**20.8**	12.8	10.4	4.5	1.5	...	.7	.7	...	...	...	...	...	.7	...	...	...	...	...	...	...	...	134	4.1	50	**14**
15	6.1	10.0	12.6	13.3	**13.6**	12.0	12.8	8.6	3.8	2.8	1.4	1.4	.5	...	.5	...	...	...	...	...	...	...	...	...	...	...	209	4.6	53	**15**
16	12.2	**16.6**	14.5	13.4	15.6	10.	13.3	1.1	1.1	...	1.1	...	...	1.1	...	...	...	...	...	...	...	...	...	...	...	...	90	3.5	66	**16**
17	4.8	7.1	6.00	11.9	**17.9**	14.3	13.1	4.7	7.1	7.1	2.4	1.2	...	1.2	...	1.2	...	...	...	...	...	...	...	...	...	...	84	5.2	49	**17**
18	3.00	**21.2**	12.1	15.2	15.1	12.1	6.1	6.1	6.1	3.00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	4.	62	**18**
19	7.2	10.8	11.7	**18.0**	14.5	12.6	10.8	8.1	5.4	.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	111	4.6	45	**19**
20	...	7.8	7.8	**25.0**	18.8	14.0	7.8	9.4	3.1	3.1	1.6	1.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	64	4.6	42	**20**
Total..	5.82	10.49	13.38	14.68	**15.00**	12.58	9.93	7.24	4.72	2.74	1.07	.99	.63	.44	.08	.16	...	.04	...	...	...	...	...	...	...	...	**2,529**	4.4	52	

TABLE XII

City Distributions—Sixth Grade—Subtraction: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1			.6	.6	.6	2.4	5.3	7.7	15.7	**17.1**	13.6	12.3	10.	3.5	4.5		3.5	.6									167	10.1	20	**1**
2				1.5	1.5	3.	17.6	13.2	**23.5**	8.8	14.6	10.3	1.5	3.		1.5											68	8.6	24	**2**
3	.3				2.6	4.3	12.5	9.5	17.5	**22.**	9.2	7.6	6.2	4.6	1.7	1.		.3	.7								305	9.6	22	**3**
4	1.4			1.4	5.6	5.6	**29.4**	16.6	25.	8.3	4.3	2.8															72	7.5	21	**4**
5				3.2	8.	9.6	17.4	**22.2**	11.1	11.1	4.7	4.7	4.8		1.6		1.6										63	7.6	26	**5**
6				.7	3.	3.7	15.6	11.1	**17.1**	16.4	12.6	6.7	8.1	2.2	.7		1.4				.7						270	8.9	24	**6**
7					3.	3.	15.2	15.2	**27.2**	18.2	9.1	9.1															33	8.5	24	**7**
8						2.8	5.8	8.6	15.7	**17.1**	11.5	12.9	12.8	8.6	1.4			1.4	1.4								70	9.9	22	**8**
9				1.	3.	7.4	13.7	13.3	14.7	14.3	**15.7**	6.4	4.	2.5	3.5	.5											203	9.8	21	**9**
10				.5	2.	2.5	9.	13.5	**25.**	17.	9.5	9.5	3.5	2.5	2.5	1.5	.5	1.									200	8.9	20	**10**
11				.6	1.8	5.3	11.1	12.9	**26.9**	18.1	9.9	9.3	3.5	.6													171	8.2	21	**11**
12					1.8	4.5	10.6	17.7	11.5	**22.2**	15.1	5.4	6.2	.8	2.7	.7		.8									113	8.9	21	**12**
13						1.6	4.7	7.8	14.	**21.8**	18.8	9.4	9.4	3.1	6.2	1.6			1.6								64	10.1	21	**13**
14					4.4	2.9	**19.7**	13.1	15.3	17.5	12.4	3.7	1.5	3.7	.7	1.5	.7	1.5	.7	.7							137	8.7	22	**14**
15		.9	1.4	1.4	2.8	6.4	13.4	11.1	19.5	**16.4**	12.8	7.4	2.3	2.8		.9				.5							217	8.5	24	**15**
16				3.3	5.7	13.3	**20.**	12.1	13.3	16.6	7.9	6.7		1.1													90	6.6	33	**16**
17			1.2			7.2	15.4	10.6	**22.6**	**22.6**	8.4	4.8	6.	1.2													84	8.5	20	**17**
18				3.03			15.2	9.1	**27.2**	21.2	9.1	6.1	6.1		3.03												33	8.9	20	**18**
19					.9	.9	11.7	15.4	19.8	**23.4**	15.3	5.4	2.7	1.8	.9		1.8										111	9.	19	**19**
20				3.1	1.6	3.1	15.6	6.3	18.7	**29.7**	12.5	3.1	3.1	1.6			1.6										64	9.1	18	**20**
Total	.079	.079	.198	.79	2.45	4.59	13.29	12.05	**18.52**	18.01	11.69	7.43	4.96	2.53	1.541	.553	.632	.316	.198	.079	.079						2,527	8.9	22	

TABLE XIII

City Distributions—Sixth Grade—Subtraction: Rights. Per Cent of Children Making Each Score

CITY	Score																										Total Number of Children	Median Score	Per Cent Variability	CITY
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25				
1	2.4	3.	4.8	4.2	6.	8.4	10.8	**13.8**	8.4	9.	10.2	4.8	6.	3.	3.6	1.2	.6	....	....	....	....	....	....	....	....	....	167	7.8	30	**1**
2	5.8	3.0	3.0	11.8	11.8	8.8	**14.7**	10.3	11.8	8.8	7.4	1.47	1.47	....	....	....	....	....	....	....	....	....	....	....	....	....	68	6.4	42	**2**
3	1.7	1.7	5.0	5.9	10.8	12.7	10.5	**17.4**	13.7	7.6	5.2	2.6	1.3	2.6	.3	.7	.3	....	....	....	....	....	....	....	....	....	305	7.1	34	**3**
4	2.8	7.0	2.8	13.9	13.9	11.0	**25.0**	8.3	8.3	5.6	1.4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	72	5.7	37	**4**
5	4.6	9.6	9.6	6.4	14.8	**17.6**	11.2	6.4	4.8	6.4	3.2	....	3.2	1.6	....	....	....	....	....	....	....	....	....	....	....	....	62	5.4	48	**5**
6	4.4	3.0	5.9	5.9	14.1	11.4	**16.4**	13.2	9.6	5.1	4.4	3.0	2.2	....	....	....	1.4	....	....	....	....	....	....	....	....	....	270	6.4	38	**6**
7	....	3.	....	3.	9.1	15.2	9.1	**30.3**	12.1	6.2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	33	7.5	25	**7**
8	2.9	4.3	7.2	7.2	**18.5**	8.1	14.3	15.7	14.3	7.2	7.2	8.6	....	....	....	1.4	....	....	....	....	....	....	....	....	....	....	70	6.4	37	**8**
9	3.0	3.5	6.4	10.8	**15.7**	11.2	10.8	14.2	9.4	4.0	4.0	3.5	2.5	.5	.5	....	....	....	....	....	....	....	....	....	....	....	203	6.2	39	**9**
10	2.0	3.0	5.0	9.5	12.5	**13.5**	12.5	13.0	12.5	7.0	3.0	3.5	1.0	1.0	.5	.5	....	....	....	....	....	....	....	....	....	....	200	6.4	38	**10**
11	.6	3.5	3.6	4.7	9.3	13.2	**20.0**	13.2	15.3	7.6	7.5	1.8	.6	....	....	....	....	....	....	....	....	....	....	....	....	....	171	6.9	31	**11**
12	.9	2.7	3.6	3.7	9.8	12.5	15.2	15.2	**16.9**	10.7	6.2	1.8	....	.9	....	....	....	.9	....	....	....	....	....	....	....	....	113	7.3	30	**12**
13	....	3.1	1.6	4.7	6.2	4.7	14.1	**21.9**	7.8	14.1	6.2	10.9	....	....	4.7	....	....	....	....	....	....	....	....	....	....	....	64	8.4	31	**13**
14	2.2	4.5	1.4	9.0	15.5	15.5	**16.3**	10.9	9.7	5.7	2.8	1.4	2.8	....	.7	1.4	....	.7	....	....	....	....	....	....	....	....	137	6.2	39	**14**
15	3.8	4.3	4.3	6.2	10.6	14.8	**15.7**	12.5	13.0	8.1	1.9	3.4	.5	....	.5	.5	....	....	....	....	....	....	....	....	....	....	209	6.3	38	**15**
16	5.5	12.1	6.6	11.	9.9	**15.4**	14.3	13.2	4.4	4.4	....	1.1	....	....	1.1	....	....	....	....	....	....	....	....	....	....	....	90	5.3	47	**16**
17	1.2	1.2	2.4	8.3	3.6	19.1	14.2	**25.0**	9.6	6.0	3.6	....	3.6	1.2	....	....	....	....	....	....	....	....	....	....	....	....	84	6.8	30	**17**
18	....	....	.6	12.2	**15.3**	6.2	12.2	6.2	9.1	....	.6	....	.3	....	....	....	....	....	....	....	....	....	....	....	....	....	33	6.	35	**18**
19	1.8	1.8	.9	8.1	11.7	17.1	14.5	**18.9**	11.7	5.4	5.4	....	.9	....	1.8	....	....	....	....	....	....	....	....	....	....	....	111	6.8	30	**19**
20	1.6	....	1.6	6.4	11.1	22.3	6.4	**27.1**	4.7	14.3	....	1.6	1.5	....	1.5	....	....	....	....	....	....	....	....	....	....	....	63	7.	36	**20**
Total..	2.54	3.49	4.36	7.33	11.56	13.11	13.98	**14.75**	11.0	7.20	4.55	2.61	1.57	.76	.71	.36	.24	.08	....	....	....	....	....	....	....	....	2,525	6.5	37	

TABLE XIV

City Distributions—Sixth Grade—Multiplication: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	1.2	....	.6	3.5	4.1	12.9	12.4	8.4	11.8	12.4	**14.8**	11.3	4.2	....	....	1.2	1.2	....	....	....	....	....	....	....	....	....	169	8.6	28	**1**
2	....	....	2.9	4.4	8.9	13.2	**22.0**	17.5	11.6	6.0	8.9	....	1.5	1.5	1.5	....	....	....	....	....	....	....	....	....	....	....	68	6.9	28	**2**
3	....	....	....	.3	5.2	8.9	**16.3**	14.1	13.5	16.1	12.8	6.2	2.0	3.3	1.0	3.	....	....	....	....	....	....	....	....	....	....	305	8.4	26	**3**
4	....	....	2.9	2.9	4.4	20.3	**23.2**	20.3	14.5	8.7	1.4	1.4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	69	6.8	25	**4**
5	....	....	8.1	11.3	9.7	19.3	**22.5**	9.7	6.5	....	6.5	4.8	....	1.6	....	....	....	....	....	....	....	....	....	....	....	....	62	6.1	33	**5**
6	....	.7	2.2	6.7	9.6	11.9	**17.8**	**17.8**	8.2	8.9	5.9	6.7	.7	1.5	.7	.7	....	....	....	....	....	....	....	....	....	....	270	7.1	33	**6**
7	....	....	....	3.1	....	15.2	15.2	15.1	12.1	**18.1**	9.1	12.1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	33	8.3	27	**7**
8	....	....	....	1.4	2.9	5.7	18.6	15.7	**18.7**	10.0	11.4	7.0	5.7	2.9	....	....	....	....	....	....	....	....	....	....	....	....	70	8.	25	**8**
9	....	....	5.	2.9	6.7	13.4	15.4	**17.7**	11.4	8.7	8.7	8.7	2.4	1.0	.5	1.0	.5	.5	....	....	....	....	....	....	....	....	208	7.4	27	**9**
10	....	1.	.5	2.	3.5	4.5	**20.**	19.	15.5	11.	7.0	7.5	3.5	2.	1.5	1.	.5	....	....	....	....	....	....	....	....	....	200	8.	24	**10**
11	....	....	....	2.4	1.2	10.6	18.8	**20.**	18.8	8.2	11.1	6.5	1.2	1.2	....	....	....	....	....	....	....	....	....	....	....	....	170	7.8	23	**11**
12	....	.9	.9	1.8	5.3	10.6	15.1	16.7	**19.4**	8.0	8.9	6.7	3.5	1.8	.9	....	....	....	....	....	....	....	....	....	....	....	113	7.9	26	**12**
13	....	....	....	1.5	1.5	1.5	9.4	**17.4**	14.1	14.1	15.6	10.9	7.8	....	1.5	4.7	....	....	....	....	....	....	....	....	....	....	64	9.4	24	**13**
14	....	.7	1.5	5.1	11.0	13.9	**20.4**	20.3	6.6	10.2	3.6	2.9	2.9	.7	....	....	....	....	....	....	....	....	....	....	....	....	137	7.	29	**14**
15	....	2.	2.9	4.8	4.8	13.4	17.1	**19.6**	10.0	7.2	8.6	4.3	3.3	1.	.5	.5	....	....	....	....	....	....	....	....	....	....	209	7.2	30	**15**
16	1.2	....	1.2	3.5	10.6	16.5	**21.1**	15.3	10.6	8.2	3.5	4.7	1.2	1.2	....	....	....	1.2	....	....	....	....	....	....	....	....	85	6.8	28	**16**
17	1.2	....	3.6	2.3	2.3	19.1	**21.3**	13.2	9.5	13.2	5.9	8.4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	84	7.5	24	**17**
18	....	....	....	9.1	6.1	9.1	15.2	9.1	**21.1**	15.2	12.1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	33	8.1	26	**18**
19	....	....	....	.9	2.8	16.4	**22.6**	21.8	12.7	7.3	9.1	3.7	1.8	.9	1.8	....	....	....	....	....	....	....	....	....	....	....	111	7.5	26	**19**
20	....	....	1.6	....	8.	11.2	24.	**32.**	6.4	4.8	9.6	4.8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	64	7.2	23	**20**
Total..	.16	.39	1.27	3.25	5.62	11.76	**17.98**	17.11	12.32	9.98	8.87	6.26	2.26	1.31	.63	5.15	.16	.08	....	....	....	....	....	....	....	....	2,526	7.6	28	

TABLE XV

City Distributions—Sixth Grade—Multiplication: Rights. Per Cent of Children Making Each Score.

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	3.6	2.4	8.9	7.7	**16.0**	14.8	8.3	10.6	8.3	8.9	4.7	2.8	1.2		.6	1.2											169	6.	41	**1**
2	2.94	13.23	16.18	**19.12**	**19.12**	16.18	2.94	4.41	1.47	1.47	2.94																68	3.9	47	**2**
3	1.31	3.30	5.58	8.52	15.08	**15.73**	13.77	12.45	12.12	5.58	3.30	.98	.98	.98	.32												305	6.	38	**3**
4	1.42	8.57	8.57	15.71	**20.**	18.57	14.30	4.28	5.72	2.86																	70	4.8	37	**4**
5	**17.46**	12.70	11.11	14.30	14.30	11.11	7.93	3.16	1.58	1.58	4.77																63	3.7	68	**5**
6	8.15	6.67	**16.30**	13.33	15.54	14.08	7.41	6.67	5.19	3.70	.74	1.48	.74														270	4.5	55	**6**
7	6.06	6.06	9.09	18.19	**21.21**	12.13	9.09	15.15		3.02																	33	4.5	50	**7**
8	5.72	7.15	8.58	10.	12.84	**21.43**	12.84	10.	5.72	2.86	2.86																70	5.3	45	**8**
9	7.35	8.82	10.79	10.79	**14.21**	11.76	9.32	10.30	4.40	6.87	3.43	.98	.49	.49													204	5.2	48	**9**
10		3.50	9.00	6.00	10.50	12.50	**19.00**	10.00	10.00	9.00	3.00	3.50	1.00	1.00	.50	.50	1.00										200	5.4	44	**10**
11	2.93	7.64	11.17	10.00	**17.70**	10.00	12.35	10.00	5.27	8.82	3.53	.59															170	5.5	47	**11**
12	1.77	4.43	11.50	8.86	15.92	**16.81**	9.74	**16.81**	5.31	6.20	1.77	.88															113	5.5	42	**12**
13		1.57	4.69	4.69	7.81	**17.18**	15.63	15.63	9.37	9.37	6.25	7.81															64	7.	35	**13**
14	6.3	7.3	19.	11.7	**17.5**	15.4	8.8	6.6	3.6	1.5	1.5		.8														137	4.4	49	**14**
15	9.6	3.3	9.1	9.6	15.8	**16.7**	13.9	4.8	6.2	4.8	3.8	1.9	.5														209	5.1	42	**15**
16	10.6	10.6	16.5	**17.7**	10.6	14.1	9.4	5.9	2.3	2.3																	85	3.7	51	**16**
17	2.4	4.8	10.7	**17.8**	13.1	11.9	10.7	9.5	13.1	3.6	2.4																84	5.4	40	**17**
18	9.1	15.1	9.1	12.2	9.1	**30.4**	3.0	6.0		6.0																	33	4.7	43	**18**
19	1.8	2.7	9.	11.7	**27.9**	14.4	14.4	10.8	1.8	2.7	1.8		1.														111	5.2	34	**19**
20		9.4	7.8	**17.2**	12.5	14.1	15.6	15.6	3.1	4.7																	64	5.4	43	**20**
Total...	4.719	5.95	10.71	10.99	**15.43**	14.67	11.46	9.4	6.35	5.31	2.62	1.27	.52	.24	.12	.12	.08										2,522	5.1	47	

TABLE XVI

City Distributions—Sixth Grade—Division: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	1.2	1.2	1.8	5.3	13.0	8.3	6.5	11.8	**14.1**	10.1	8.9	1.8	5.9	3.5	2.4	1.2	1.8	.6	.6	...	...	...	...	...	...	...	169	8.1	36	**1**
2	...	...	10.3	**20.6**	20.5	4.4	4.4	10.3	10.3	6.0	2.9	2.9	2.9	...	1.5	1.5	1.5	...	...	...	...	...	...	...	...	...	68	4.9	47	**2**
3	...	...	2.0	8.2	13.1	8.9	9.5	**17.5**	12.8	7.5	6.2	6.2	3.9	2.6	1.0	.3	.3	...	...	...	...	...	...	...	...	...	305	7.5	35	**3**
4	...	1.4	7.3	8.7	17.4	10.1	11.6	**18.9**	11.6	7.3	2.9	1.4	1.4	...	...	...	...	...	...	...	...	...	...	...	...	...	69	6.4	35	**4**
5	...	1.6	4.8	**22.1**	17.5	14.3	1.6	7.9	12.7	6.3	3.2	1.6	3.2	...	1.6	1.6	...	...	...	...	...	...	...	...	...	...	63	5.3	49	**5**
6	.7	3.0	3.0	17.8	**21.4**	11.9	5.2	13.3	5.9	5.9	5.2	...	3.	1.5	...	.7	1.5	...	...	...	...	...	...	...	...	...	270	5.8	40	**6**
7	6.1	3.1	...	3.1	**30.2**	12.1	15.1	15.1	6.1	9.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	5.7	31	**7**
8	...	1.4	1.4	4.3	**20.**	11.4	5.7	15.6	10.0	10.0	5.7	5.7	2.9	2.9	1.4	...	1.4	...	...	...	...	...	...	...	...	...	70	7.2	36	**8**
9	.5	2.5	5.0	13.4	**17.7**	7.9	9.4	14.8	10.4	3.5	5.9	3.5	3.5	1.0	...	.5	.5	...	...	...	...	...	...	...	...	...	202	6.1	44	**9**
10	...	.5	3.5	5.	7.5	**16.5**	13.0	14.5	13.0	6.0	8.0	4.0	2.0	2.5	.5	2.0	.5	...	.5	.5	...	...	...	...	...	...	200	7.3	37	**10**
11	...	1.2	4.1	12.4	**25.8**	12.4	8.8	9.4	10.5	4.7	4.1	2.4	2.4	1.2	...	.6	...	...	...	...	...	...	...	...	...	...	170	5.	40	**11**
12	...	3.5	7.1	13.3	**18.5**	13.5	9.7	13.3	6.2	2.7	5.3	2.7	.9	3.5	...	...	...	...	...	...	...	...	...	...	...	...	113	5.9	39	**12**
13	...	1.5	3.1	3.1	12.5	4.7	11.0	7.8	**14.2**	6.3	11.0	7.8	7.8	3.1	3.1	1.5	...	...	...	1.5	...	...	...	...	...	...	64	8.8	34	**13**
14	.7	5.8	5.8	14.6	**24.9**	13.1	8.0	8.8	7.3	2.9	2.2	2.2	.7	1.5	1.5	...	...	...	...	...	...	...	...	...	...	...	137	5.3	41	**14**
15	2.0	1.0	3.3	14.3	**21.0**	6.2	7.7	12.3	8.6	5.3	7.2	5.3	3.3	.5	1.0	1.0	...	...	...	...	...	...	...	...	...	...	209	6.4	44	**15**
16	1.2	3.5	8.1	**20.6**	14.9	16.0	8.1	13.8	6.9	2.3	2.3	...	...	...	...	2.3	...	...	...	...	...	...	...	...	...	...	87	5.1	45	**16**
17	...	2.3	3.6	10.7	13.1	8.4	10.7	**19.2**	9.5	7.1	8.3	2.3	4.8	...	...	...	...	...	...	...	...	...	...	...	...	...	84	2.1	35	**17**
18	...	...	...	12.1	**27.2**	9.1	9.1	3.0	12.1	6.1	...	6.1	3.0	6.1	6.1	...	...	...	...	...	...	...	...	...	...	...	33	6.3	44	**18**
19	.9	3.7	.9	8.1	9.1	10.8	7.3	**18.8**	11.6	10.7	5.4	5.4	3.7	1.8	...	.9	.9	...	...	...	...	...	...	...	...	...	111	7.7	30	**19**
20	...	1.6	7.8	6.3	**12.4**	**20.2**	6.3	14.1	10.9	6.3	3.1	6.3	...	3.1	1.6	...	...	...	...	...	...	...	...	...	...	...	64	6.5	35	**20**
Total..	.56	1.91	3.89	11.47	**17.22**	10.8	8.37	13.57	10.24	6.11	5.59	3.38	2.98	1.75	.8	.78	.52	.14	.12	.08	...	...	...	...	...	...	2,521	5.7	46	

TABLE XVII

City Distributions—Sixth Grade—Division: Rights. Per Cent of Children Making Each Score

CITY	Score																										Total Number of Children	Median Score	Per Cent Variability	CITY
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25				
1	7.1	5.3	**13.**	5.3	7.6	4.1	**13.**	8.8	8.3	7.1	7.1	1.7	5.3	2.8	1.2	.6	1.1	....	.6	....	....	....	....	....	....	....	169	6.6	56	**1**
2	10.3	5.8	14.	**17.6**	14.7	2.9	5.8	7.3	8.7	4.3	1.4	2.9	....	....	1.4	2.9	....	....	....	....	....	....	....	....	....	....	68	4.2	67	**2**
3	3.3	5.9	8.9	10.5	10.1	**11.5**	10.5	9.2	10.1	6.2	5.6	2.	2.9	2.	.7	.3	.3	....	....	....	....	....	....	....	....	....	305	6.	48	**3**
4	....	8.4	8.4	11.1	8.4	12.4	**16.7**	12.4	12.4	5.6	1.4	1.4	1.4	....	....	....	....	....	....	....	....	....	....	....	....	....	72	6.	39	**4**
5	11.1	19.1	**14.3**	12.7	1.6	4.8	11.1	7.9	7.9	4.8	....	1.6	1.6	1.6	....	....	....	....	....	....	....	....	....	....	....	....	63	3.5	83	**5**
6	12.5	**15.5**	11.7	**15.5**	11.6	6.6	4.4	7.3	5.1	3.2	1.8	2.5	.3	1.4	.6	....	....	....	....	....	....	....	....	....	....	....	270	3.9	70	**6**
7	6.3	15.6	15.6	3.1	**15.7**	12.5	12.5	12.5	3.1	3.1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	32	4.6	59	**7**
8	7.2	7.2	12.8	**14.3**	8.5	10.	11.4	5.7	2.9	8.6	7.2	....	1.4	....	1.4	....	1.4	....	....	....	....	....	....	....	....	....	70	4.9	65	**8**
9	10.4	**12.4**	11.9	11.9	9.9	11.3	9.4	5.9	4.9	3.5	4.5	2.	1.	1.	....	....	....	....	....	....	....	....	....	....	....	....	202	4.4	58	**9**
10	6.5	10.	6.	8.	14.	**15.**	11.5	9.	5.	4.	3.	1.5	1.	2.5	....	1.5	.5	....	.5	.5	....	....	....	....	....	....	200	5.4	48	**10**
11	10.6	10.6	**15.9**	14.1	12.3	10.6	7.	5.9	4.1	1.8	4.1	1.2	.6	.6	.6	....	....	....	....	....	....	....	....	....	....	....	170	3.7	64	**11**
12	5.3	12.4	14.1	10.6	10.6	**15.**	9.8	8.8	5.3	1.8	1.8	1.8	2.7	....	....	....	....	....	....	....	....	....	....	....	....	....	113	4.9	53	**12**
13	3.2	4.8	7.9	7.9	6.3	6.3	9.5	**16.**	9.5	6.3	7.9	4.8	4.8	3.2	....	1.6	....	....	....	....	....	....	....	....	....	....	63	7.3	44	**13**
14	15.3	16.	**16.8**	**16.8**	6.6	5.1	5.8	6.6	2.9	2.2	1.5	1.5	.7	2.2	....	....	....	....	....	....	....	....	....	....	....	....	137	3.3	66	**14**
15	8.6	10.5	**14.9**	9.	9.	6.3	9.5	8.6	6.3	4.8	5.3	4.3	1.	....	1.4	.5	....	....	....	....	....	....	....	....	....	....	209	4.8	67	**15**
16	17.2	**18.4**	10.4	10.4	12.7	10.4	5.7	6.9	2.3	1.1	2.3	....	....	....	1.1	1.1	....	....	....	....	....	....	....	....	....	....	87	3.9	67	**16**
17	6.	8.4	11.9	7.2	4.8	11.8	6.	**21.3**	7.2	4.8	4.8	2.3	3.5	....	....	....	....	....	....	....	....	....	....	....	....	....	84	6.5	47	**17**
18	8.3	8.3	**22.3**	8.3	8.3	2.9	2.9	8.4	8.4	8.4	2.7	5.6	2.6	2.6	....	....	....	....	....	....	....	....	....	....	....	....	36	4.	80	**18**
19	9.	3.6	8.1	9.9	11.7	**11.8**	10.8	9.	9.	9.	3.6	.9	2.7	....	....	....	.9	....	....	....	....	....	....	....	....	....	111	5.9	47	**19**
20	7.8	7.8	9.3	6.3	12.5	14.	6.3	**15.6**	7.8	3.1	4.7	....	1.6	1.6	1.6	....	....	....	....	....	....	....	....	....	....	....	64	5.4	50	**20**
Total..	8.48	10.3	**11.76**	11.01	10.06	9.47	8.99	8.87	6.49	4.52	3.84	1.74	1.94	1.11	.63	.48	.24	....	.08	.039	....	....	....	....	....	....	2,525	4.8	60	

TABLE XVIII

City Distributions—Seventh Grade—Addition: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	....	....	....	....	2.4	3.2	14.5	12.9	**22.6**	10.5	10.5	9.7	3.2	2.4	4.9	1.6	1.6	....	....	....	....	....	....	....	....	....	124	8.9	27	**1**
2	....	....	....	....	5.1	8.5	**33.8**	13.5	10.2	11.9	8.5	5.1	....	3.4	....	....	....	....	....	....	....	....	....	....	....	....	59	7.2	25	**2**
3	....	.4	1.2	.8	2.7	7.8	12.4	14.	**19.9**	15.7	9.	6.7	3.1	2.7	1.2	1.6	.4	.4	.4	....	....	....	....	....	....	....	251	9.	22	**3**
4	....	....	2.8	7.	13.9	15.3	**19.3**	16.7	16.6	4.2	2.8	1.4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	72	6.8	28	**4**
5	....	....	....	1.7	13.3	16.6	**23.2**	11.7	13.3	10.	3.3	3.3	1.7	....	....	....	....	....	....	....	....	1.7	....	....	....	....	60	6.8	28	**5**
6	....	....	1.6	1.6	4.1	9.8	**21.3**	20.5	12.3	15.6	6.6	3.3	1.6	....	.8	....	....	.8	....	....	....	....	....	....	....	....	122	6.5	25	**6**
7	....	....	....	....	2.8	8.3	16.7	16.7	11.1	**22.1**	16.7	5.6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	36	8.7	23	**7**
8	....	....	....	....	5.6	**23.6**	22.3	19.3	12.5	11.1	4.2	....	....	1.4	....	....	....	....	....	....	....	....	....	....	....	....	72	8.	22	**8**
9	....	....	.8	1.6	3.3	6.6	9.8	13.1	**15.5**	13.1	10.7	9.	4.9	4.9	1.6	1.6	3.3	....	....	....	....	....	....	....	....	....	122	9.3	23	**9**
10	....	....	....	....	2.4	6.9	10.6	17.6	13.8	**19.5**	9.4	8.8	5.6	1.2	1.2	.6	1.8	.6	....	....	....	....	....	....	....	....	160	8.9	22	**10**
11	....	....	.9	4.5	5.4	8.1	24.	9.8	16.1	**16.9**	8.9	1.8	1.8	....	.9	.9	....	....	....	....	....	....	....	....	....	....	112	6.7	26	**11**
12	....	....	1.	1.	3.8	7.8	**24.4**	19.4	16.5	7.8	8.7	4.8	1.9	1.9	....	....	....	1.	....	....	....	....	....	....	....	....	103	7.7	25	**12**
13	....	....	....	....	1.5	9.1	10.6	**22.9**	21.3	16.9	9.1	4.6	....	1.5	....	1.5	....	....	....	....	....	....	....	....	....	....	65	8.2	21	**13**
14	....	....	....	....	7.4	17.4	16.3	**21.2**	16.2	8.8	6.3	3.8	1.3	1.3	....	....	....	....	....	....	....	....	....	....	....	....	80	7.2	23	**14**
15	....	....	....	1.2	4.2	6.	15.7	14.9	**16.3**	11.9	11.9	6.6	4.2	4.2	.6	.6	.6	.6	....	....	....	.6	....	....	....	....	167	8.6	27	**15**
16	....	....	....	1.5	1.5	13.2	13.2	**20.7**	13.2	14.8	4.4	8.9	4.4	....	2.9	1.5	....	....	....	....	....	....	....	....	....	....	68	8.	29	**16**
17	....	....	....	....	1.5	4.5	9.	11.9	13.4	**25.3**	13.4	7.5	3.	7.5	3.	....	....	....	....	....	....	....	....	....	....	....	67	9.4	21	**17**
18	....	....	....	....	....	5.6	**24.1**	**24.1**	12.9	7.4	14.7	7.4	1.9	....	1.9	....	....	....	....	....	....	....	....	....	....	....	54	8.	23	**18**
19	....	....	....	1.6	8.2	14.8	14.9	**22.9**	16.4	9.8	3.3	4.9	1.6	1.6	....	....	....	....	....	....	....	....	....	....	....	....	61	8.2	21	**19**
20	....	....	....	8.9	17.9	8.9	12.4	**19.6**	16.1	5.4	5.4	1.8	1.8	1.8	....	....	....	....	....	....	....	....	....	....	....	....	56	7.1	30	20
Total..	....	.05	.52	1.36	4.19	8.32	**16.59**	16.33	16.48	13.61	9.06	5.8	2.7	2.03	1.15	.67	.57	.26	.05	....	....	.1	....	....	....	....	1,911	8.1	26	

TABLE XIX

City Distributions—Seventh Grade—Addition: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	2.4	4.8	5.6	12.1	13.7	16.1	**18.5**	8.1	6.4	3.2	4.1	2.4	1.6	...	.9	...	...	...	...	...	...	...	...	...	...	...	124	5.7	39	**1**
2	6.8	11.9	**20.3**	16.9	15.2	6.8	5.1	5.1	6.8	3.4	1.7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	59	3.7	51	**2**
3	2.	2.	7.2	10.4	11.1	12.6	13.1	**17.0**	9.2	5.6	3.5	3.1	1.2	.8	.8	...	...	...	...	...	...	...	...	...	...	...	251	6.4	37	**3**
4	1.4	7.0	**18.0**	15.3	15.3	16.6	13.8	5.6	5.6	...	1.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	72	4.7	43	**4**
5	3.3	10.0	6.7	20.0	**21.4**	10.0	15.1	6.7	3.3	...	...	1.7	...	...	...	...	...	...	...	...	1.7	...	...	...	...	...	60	4.5	42	**5**
6	3.3	9.8	19.8	13.2	**18.1**	9.0	13.1	4.9	2.4	1.6	1.6	.8	.8	.8	...	.8	...	...	...	...	...	...	...	...	...	...	122	4.2	51	**6**
7	...	2.9	**22.8**	14.2	20.1	11.4	11.3	8.6	5.8	2.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	35	4.2	48	**7**
8	7.0	12.5	7.0	15.3	**16.6**	13.8	12.4	8.3	7.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	72	4.5	49	**8**
9	3.3	7.3	12.4	7.3	**16.5**	15.6	13.3	4.9	6.5	6.5	2.4	1.6	1.6	...	...	.8	...	...	...	...	...	...	...	...	...	...	122	5.4	42	**9**
10	3.1	5.6	1.1	9.4	12.0	**21.3**	16.3	5.	6.2	2.5	3.7	1.9	1.3	...	...	.7	...	...	...	...	...	...	...	...	...	...	160	5.4	37	**10**
11	6.3	10.7	15.2	12.5	**16.0**	7.1	15.2	3.6	6.2	4.5	.9	...	...	.9	.9	...	...	...	...	...	...	...	...	...	...	...	112	4.7	51	**11**
12	3.8	5.8	9.7	5.8	**22.4**	16.6	15.7	9.7	3.8	1.9	2.9	1.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	103	5.2	35	**12**
13	1.5	6.1	10.5	10.5	18.1	**19.6**	12.2	6.1	6.1	3.3	4.5	1.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	66	5.1	42	**13**
14	7.4	10.0	13.7	6.2	**25.0**	15.1	15.1	3.8	2.5	1.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	80	4.9	44	**14**
15	3.6	12.0	10.2	11.3	13.7	12.0	**13.8**	6.0	6.0	6.0	1.8	1.2	1.8	...	...	...	...	...	.6	...	...	...	...	...	...	...	167	4.9	50	**15**
16	10.5	11.9	9.2	**15.8**	11.9	10.5	9.2	2.6	5.3	2.6	1.3	5.3	3.9	...	...	...	...	...	...	...	...	...	...	...	...	...	76	4.2	60	**16**
17	4.5	14.9	1.5	14.9	9.0	10.4	**19.3**	4.5	6.	9.	3.	3.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	67	5.5	44	**17**
18	1.9	1.9	7.4	7.4	**22.1**	20.4	12.9	5.6	12.9	5.6	1.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	54	5.8	36	**18**
19	8.2	4.9	21.4	**22.9**	9.8	14.9	9.8	...	4.9	...	1.6	1.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	61	3.7	34	**19**
20	1.8	7.2	12.4	**19.6**	9.0	**19.6**	12.4	7.2	5.4	1.8	1.8	1.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	56	4.7	43	**20**
Total..	3.91	7.61	11.37	12.04	**15.22**	13.97	13.81	7.09	6.1	3.49	2.24	1.62	.83	.21	.21	.16	...	...	.05	...	.05	...	...	...	...	...	1,919	4.9	49	

TABLE XX

City Distributions—Seventh Grade—Subtraction: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1						.8	3.3	7.3	3.3	16.2	**17.1**	**17.1**	8.9	5.7	5.7	4.9	3.3	.8	1.6	.8	2.4		.8				123	11.3	21	**1**
2					1.7		6.8	8.5	**22.**	18.7	10.1	8.5	13.5	1.7	1.7	1.7	3.4	1.7									59	9.6	22	**2**
3			.4		.4	.4	.4	9.8	14.8	**20.8**	19.9	10.3	6.8	6.4	3.6	.4	1.2	.4	.4								251	10.	19	**3**
4			1.4		9.7	5.6	**20.8**	13.9	**20.8**	13.8	5.6	2.8	2.8		2.8												72	7.6	27	**4**
5				1.7	1.7	3.3	8.3	10.	8.3	15.1	13.3	**16.6**	11.7	5.			3.3			1.7							60	10.1	23	**5**
6				.8	.8	.8	2.5	7.4	7.4	**18.2**	16.1																122	10.6	23	**6**
7							2.8	11.1	8.3	19.4	**19.5**	8.3	11.1	8.3	2.8	5.6	2.8										36	10.7	20	**7**
8							4.2	11.1	15.3	16.7	**23.5**	12.5	4.2	6.9	1.4		1.4	2.8									72	10.1	18	**8**
9					.8		2.5	4.1	14.1	16.5	10.7	**17.4**	11.6	6.6	6.6	.8	5.0	2.5		.8							121	10.9	19	**9**
10						1.2	3.1	6.9	12.5	10.6	**20.7**	11.9	10.1	6.9	6.9	3.1	3.1	1.2	.6	.6		.6					160	10.8	19	**10**
11					.9	4.4	6.2	17.7	13.3	**18.5**	16.8	9.7	6.2	2.7	1.8	.9	.9										113	9.5	23	**11**
12		1.			1.	2.9	5.9	8.8	10.8	**21.5**	12.7	11.8	11.8	7.8	1.		1.		1.			1.					102	10.1	23	**12**
13							6.1	6.1	9.1	**22.6**	16.7	13.6	9.1	4.5	6.1	3.1	1.5	1.5									66	10.2	20	**13**
14								11.3	15.	13.7	**17.4**	10.	8.7	8.7	3.8	3.8	3.8	1.3	2.5								80	10.8	23	**14**
15					1.2	1.8	5.4	12.6	13.8	**15.6**	12.6	11.4	9.	4.2	3.	4.8	3.4		1.2								167	10.1	22	**15**
16					1.5	5.8		14.4	14.4	**23.1**	7.3	8.7	5.8	10.1	2.9	1.5		1.5	1.5		1.5						69	9.6	24	**16**
17					1.5			2.9	4.5	11.9	20.9	**22.5**	14.9	7.9	1.5	4.5	2.9	4.5									67	11.4	16	**17**
18					1.9		1.9	5.6	16.7	14.7	11.1	14.7	**20.3**	7.4	5.6												54	10.9	19	**18**
19							1.6	8.2	18.1	**21.3**	16.4	11.5	13.1	3.3	1.6	3.3	1.6										61	9.9	19	**19**
20					3.6	1.8	**19.5**	8.9	16.1	7.1	14.3	8.9	5.4	5.4	3.6	1.8	1.8						1.8				56	9.	31	**20**
Total..		.05	.16	.10	1.1	1.51	5.13	9.24	13.4	**16.8**	15.7	12.09	9.16	5.49	9.16	1.99	2.1	.84	.52	.26	.26	.10	.10				1,911	10.2	22	

TABLE XXI

City Distributions—Seventh Grade—Subtraction: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	.8	1.6	.8	3.3	4.1	6.5	11.4	**16.4**	13.8	8.1	9.8	7.3	4.1	1.6	2.4	2.4	1.6	.8	1.6	.8	.8	....	....	....	....	....	123	8.6	31	**1**
2	1.7	....	3.4	5.1	5.1	12.	8.5	8.5	**20.5**	12.	6.8	10.3	1.7	3.4	1.7	....	....	....	....	....	....	....	....	....	....	....	59	8.3	33	**2**
3	.8	.4	1.2	3.5	3.5	7.6	11.6	14.5	**19.9**	11.1	10.4	7.2	3.5	1.6	2.	....	.8	.4	....	....	....	....	....	....	....	....	251	8.4	26	**3**
4	2.7	1.4	1.4	5.5	9.6	16.3	**19.2**	15.1	15.1	9.6	....	1.4	2.7	....	....	....	....	....	....	....	....	....	....	....	....	....	73	6.7	29	**4**
5	3.3	....	....	5.	10.	10.	8.3	8.3	13.4	**20.1**	8.3	6.7	3.3	....	....	3.3	....	....	....	....	....	....	....	....	....	....	60	8.4	30	**5**
6	1.6	4.1	.8	5.7	10.7	9.8	**17.3**	16.5	9.	9.	4.9	3.3	3.3	.8	.8	.8	....	.8	....	.8	....	....	....	....	....	....	122	7.	32	**6**
7	....	....	2.8	8.3	11.1	8.3	5.6	13.9	16.6	**19.4**	2.8	2.8	....	5.6	2.8	....	....	....	....	....	....	....	....	....	....	....	36	7.7	33	**7**
8	....	....	2.9	4.2	16.5	11.	**18.**	15.3	5.6	12.4	7.	1.4	1.4	2.8	....	....	1.4	....	....	....	....	....	....	....	....	....	72	7.	32	**8**
9	.8	.8	1.6	2.5	5.	7.4	9.1	**18.3**	13.3	11.6	7.4	8.3	5.	5.8	2.5	....	....	....	....	.8	....	....	....	....	....	....	121	8.8	26	**9**
10	.7	.7	1.3	3.7	5.	10.1	8.1	**15.5**	12.4	10.1	13.	10.5	3.7	1.3	1.9	1.3	....	.7	....	....	....	....	....	....	....	....	160	8.4	31	**10**
11	.9	1.7	2.6	8.7	12.2	**14.7**	13.8	12.2	9.5	10.5	3.5	6.1	.9	.9	.9	....	.9	....	....	....	....	....	....	....	....	....	115	6.6	33	**11**
12	....	1.	....	5.8	1.	8.7	9.6	12.5	16.2	**17.2**	8.7	6.7	7.7	1.	1.	1.9	....	....	1.	....	....	....	....	....	....	....	104	8.8	26	**12**
13	....	....	1.5	3.	6.1	9.1	13.6	**15.2**	12.2	13.6	7.6	9.1	3.	3.	3.	....	....	....	....	....	....	....	....	....	....	....	66	8.1	29	**13**
14	2.5	1.2	2.5	3.8	10.	3.8	7.5	**13.7**	12.5	8.8	10.	10.	6.2	2.5	....	....	2.5	2.5	....	....	....	....	....	....	....	....	80	8.4	36	**14**
15	3.	1.8	3.	7.2	11.3	12.5	10.2	12.	**14.4**	4.2	6.	6.	2.4	2.4	1.8	1.2	.6	....	....	....	....	....	....	....	....	....	167	7.1	38	**15**
16	2.9	2.9	2.9	4.4	14.5	**17.5**	8.5	15.9	11.6	7.2	4.4	2.9	....	....	1.5	2.9	....	....	....	....	....	....	....	....	....	....	69	6.7	34	**16**
17	3.	1.5	1.5	3.	6.	11.9	10.4	**17.8**	13.4	9.	9.	1.5	1.5	6.	4.5	....	....	....	....	....	....	....	....	....	....	....	67	7.8	31	**17**
18	....	1.9	1.9	3.7	3.7	9.3	7.4	11.1	11.1	**12.9**	11.1	11.1	11.1	....	3.7	....	....	....	....	....	....	....	....	....	....	....	54	9.1	29	**18**
19	1.6	....	6.6	4.9	6.6	13.1	18.1	11.5	**21.3**	8.2	1.6	3.3	1.6	1.6	....	....	....	....	....	....	....	....	....	....	....	....	61	7.1	29	**19**
20	....	3.6	1.8	1.8	8.9	**19.5**	8.9	7.2	10.7	16.	7.2	5.4	3.6	3.6	....	....	....	....	....	....	....	1.8	....	....	....	....	56	7.8	32	**20**
Total..	1.3	1.25	1.82	4.64	8.04	10.44	11.39	**14.09**	14.04	10.75	8.13	6.42	3.45	2.03	1.56	.73	.47	.31	.16	.16	.05	.05	....	....	....	....	1,916	7.8	32	

TABLE XXII

City Distributions—Seventh Grade—Multiplication: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	.9	....	....	....	.9	4.8	10.6	11.4	13.	15.3	11.4	**17.7**	5.6	2.4	2.4	.9	1.6	....	.9	.9	....	....	....	....	....	....	124	9.7	25	**1**
2	....	....	1.7	1.7	....	10.2	**18.6**	16.8	8.5	13.6	13.6	6.8	3.4	1.7	1.7	1.7	....	....	....	....	....	....	....	....	....	....	59	8.2	29	**2**
3	....	....	....	....	2.4	3.1	11.6	14.7	15.5	15.1	**17.6**	10.8	5.2	1.2	2.	.8	....	....	....	....	....	....	....	....	....	....	251	9.2	23	**3**
4	....	....	1.4	4.2	5.6	12.8	**30.9**	16.9	9.9	8.5	7.	1.4	1.4	....	....	....	....	....	....	....	....	....	....	....	....	....	71	6.9	26	**4**
5	....	....	1.7	1.7	....	11.7	**15.**	13.2	**15.**	11.7	6.7	11.7	5.	5.	....	1.7	....	....	....	....	....	....	....	....	....	....	60	8.4	30	**5**
6	....	....	....	3.3	3.3	**21.2**	19.7	18.1	10.7	9.8	7.4	4.1	.8	....	.8	.8	....	....	....	....	....	....	....	....	....	....	122	7.1	27	**6**
7	....	....	....	....	2.8	....	8.3	**24.9**	5.6	**24.9**	16.7	2.8	5.6	5.6	....	....	2.8	....	....	....	....	....	....	....	....	....	36	7.8	24	**7**
8	....	....	....	.8	1.6	4.1	9.8	13.1	14.8	**16.5**	15.7	5.7	9.8	3.3	1.6	1.6	.8	.8	....	....	....	....	....	....	....	....	72	8.4	23	**8**
9	....	1.4	....	....	1.4	9.7	13.9	16.7	13.9	**22.1**	11.1	5.6	1.4	....	1.4	....	1.4	....	....	....	....	....	....	....	....	....	122	9.4	20	**9**
10	....	....	....	.5	1.9	1.9	6.3	8.1	13.1	13.8	**18.7**	10.	10.	6.9	3.1	1.2	3.1	.5	....	....	....	.5	....	....	....	....	160	10.2	22	**10**
11	....	....	....	1.8	....	13.3	19.4	12.4	**15.8**	13.3	13.3	7.1	2.7	....	.9	....	....	....	....	....	....	....	....	....	....	....	113	8.2	27	**11**
12	....	....	....	4.8	4.8	7.8	18.4	**19.4**	12.6	11.7	7.8	6.8	3.9	....	....	1.	....	....	....	....	1.	....	....	....	....	....	103	7.7	26	**12**
13	....	....	....	....	4.5	1.5	**14.9**	7.5	**14.9**	**14.9**	**14.9**	7.5	10.4	7.5	....	1.5	....	....	....	....	....	....	....	....	....	....	67	9.5	27	**13**
14	....	....	....	1.2	6.3	7.5	**17.5**	16.1	11.3	**17.5**	8.8	8.8	3.8	1.2	....	....	....	....	....	....	....	....	....	....	....	....	80	8.3	27	**14**
15	....	....	.6	3.	5.4	11.4	14.9	**19.2**	11.9	10.8	8.4	7.2	4.2	1.2	1.2	.6	....	....	....	....	....	....	....	....	....	....	167	7.8	29	**15**
16	....	....	2.8	4.2	5.6	**16.6**	12.5	11.1	8.3	8.3	9.7	8.3	4.2	4.2	2.8	1.4	....	....	....	....	....	....	....	....	....	....	72	7.8	34	**16**
17	....	....	....	....	3.	1.5	3.	**19.4**	6.	9.	16.3	16.3	10.5	6.	....	6.	....	1.5	1.5	....	....	....	....	....	....	....	67	10.6	24	**17**
18	....	1.8	....	....	1.8	9.7	14.7	**22.2**	14.7	5.6	14.7	7.4	5.6	....	1.8	....	....	....	....	....	....	....	....	....	....	....	54	8.4	20	**18**
19	....	....	....	1.6	....	3.3	19.7	11.5	16.4	13.1	**21.3**	3.3	3.3	....	3.3	....	....	1.6	....	....	1.6	....	....	....	....	....	61	8.6	24	**19**
20	....	....	....	1.8	3.6	3.6	16.	**28.5**	10.6	8.9	5.4	5.4	5.4	1.8	3.6	....	1.8	1.8	....	1.8	....	....	....	....	....	....	56	7.9	24	**20**
Total..	.05	.1	.31	1.52	2.77	7.73	14.25	**15.29**	12.74	13.26	12.69	8.31	5.22	2.25	1.47	.95	.57	.26	.1	.1	.10	.05	....	....	....	....	1,917	8.6	27	

TABLE XXIII

City Distributions—Seventh Grade—Multiplication: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	1.6	2.4	4.8	6.5	**14.4**	12.1	10.5	**14.4**	11.3	8.1	4.8	3.2	3.2	.9	.9	....	.9	....	....	....	....	....	....	....	....	....	124	6.9	36	**1**
2	3.4	11.8	5.8	8.5	**20.2**	13.5	5.8	8.5	8.5	6.8	5.8	3.4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	59	5.1	53	**2**
3	....	1.6	1.6	6.4	9.2	12.8	**21.1**	15.8	12.8	9.2	3.1	3.6	1.6	.8	....	.4	....	....	....	....	....	....	....	....	....	....	251	6.9	29	**3**
4	4.2	1.4	4.2	11.3	15.5	**19.7**	**19.7**	9.9	9.9	1.4	1.4	....	1.4	....	....	....	....	....	....	....	....	....	....	....	....	....	71	5.6	33	**4**
5	....	3.3	10.	3.3	13.4	**21.6**	15.	8.3	8.3	1.7	11.7	1.7	1.7	....	....	....	....	....	....	....	....	....	....	....	....	....	60	5.9	34	**5**
6	3.3	7.4	17.2	13.8	17.2	**18.1**	6.6	4.9	7.4	2.5	1.6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	122	4.6	49	**6**
7	2.8	5.6	11.1	8.3	**19.4**	**19.4**	13.9	11.1	....	5.6	2.8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	36	5.6	37	**7**
8	2.8	4.2	13.9	13.9	12.5	9.7	**20.8**	9.7	8.3	1.4	1.4	....	....	1.4	....	....	....	....	....	....	....	....	....	....	....	....	72	5.3	43	**8**
9	1.6	4.1	1.6	**13.9**	9.8	10.7	11.5	13.2	10.7	11.5	8.2	1.6	.8	....	....	.8	....	....	....	....	....	....	....	....	....	....	122	4.6	37	**9**
10	.6	1.9	3.1	7.5	8.7	6.9	15.	**16.2**	15.	10.6	5.9	4.9	1.9	....	.6	.6	.6	....	....	....	....	....	....	....	....	....	160	7.4	28	**10**
11	.9	8.	8.	14.1	12.4	**15.9**	**15.9**	7.1	5.3	8.	3.5	....	.9	....	....	....	....	....	....	....	....	....	....	....	....	....	113	5.4	41	**11**
12	2.9	2.9	8.7	9.7	18.4	**21.4**	6.8	11.7	5.8	3.9	2.9	3.9	....	1.	....	....	....	....	....	....	....	....	....	....	....	....	103	5.3	39	**12**
13	3.	3.	1.5	4.5	14.9	**19.4**	10.4	13.4	7.5	6.	10.4	1.5	4.5	....	....	....	....	....	....	....	....	....	....	....	....	....	67	6.6	34	**13**
14	1.3	6.3	8.8	16.2	13.7	**17.4**	11.2	10.	6.3	6.3	2.5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	80	5.2	46	**14**
15	3.	6.6	6.6	13.2	13.8	**19.8**	14.9	7.8	5.4	5.4	1.8	1.8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	167	5.4	37	**15**
16	8.3	12.5	5.6	16.7	**18.**	12.5	5.6	8.3	5.6	2.8	1.4	....	1.4	1.4	....	....	....	....	....	....	....	....	....	....	....	....	72	4.4	59	**16**
17	3.	4.5	6.	10.4	**16.4**	10.3	7.5	4.5	**16.4**	7.5	6.	4.5	3.	....	....	....	....	....	....	....	....	....	....	....	....	....	67	6.1	47	**17**
18	5.6	3.7	7.4	9.3	7.4	12.9	**16.6**	1.9	**16.6**	7.4	5.6	5.6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	54	6.6	40	**18**
19	3.3	1.6	16.4	13.1	6.6	**22.9**	14.8	6.6	6.6	4.9	1.6	....	....	1.6	....	....	....	....	....	....	....	....	....	....	....	....	61	5.1	44	**19**
20	1.8	5.4	7.1	7.1	14.2	16.	10.8	**19.6**	5.4	5.4	1.8	....	3.6	....	....	....	....	1.8	....	....	....	....	....	....	....	....	56	5.8	40	**20**
Total..	2.25	4.54	6.64	10.34	13.16	**15.03**	13.42	10.91	9.24	6.48	4.02	2.09	1.2	.36	.1	.16	.1	.05	....	....	....	....	....	....	....	....	1,917	5.9	41	

TABLE XXIV

City Distributions—Seventh Grade—Division: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	.9	1.6	....	1.6	3.2	3.2	3.2	8.1	**16.**	7.3	10.5	8.9	14.5	5.6	6.5	1.6	3.2	.9	1.6	....	1.6	....	....	....	....	....	124	10.8	25	**1**
2	....	1.7	1.7	8.5	**22.**	6.8	6.8	11.8	11.8	6.8	10.2	1.7	6.8	1.7	....	1.7	....	....	....	....	....	....	....	....	....	....	59	7.3	44	**2**
3	....	.4	.4	2.	3.1	6.	7.6	11.9	**14.2**	13.2	11.	11.	8.	4.4	2.8	2.4	.8	....	.4	.4	....	....	....	....	....	....	251	9.3	27	**3**
4	....	1.4	5.6	12.7	**15.6**	14.1	7.	**15.6**	7.	4.2	5.6	2.8	4.2	....	2.8	....	1.4	....	....	....	....	....	....	....	....	....	71	6.4	40	**4**
5	....	1.7	5.	5.	6.7	3.3	3.3	**15.**	6.7	6.7	11.6	8.3	5.	3.3	6.7	....	3.3	3.3	1.7	1.7	....	....	1.7	....	....	....	60	9.2	34	**5**
6	....	1.6	2.5	4.9	**20.5**	8.2	6.6	16.	9.8	7.4	8.2	3.3	5.7	1.6	.8	1.6	.8	....	....	....	....	....	....	....	....	....	122	7.4	22	**6**
7	....	....	2.9	2.9	8.6	5.7	2.9	**14.2**	8.6	11.4	11.4	5.7	11.4	....	8.6	....	5.7	....	....	....	....	....	....	....	....	....	35	7.7	45	**7**
8	....	....	2.8	4.2	11.1	5.6	11.1	**18.**	13.9	8.3	9.7	9.7	1.4	1.4	1.4	1.4	....	....	....	....	....	....	....	....	....	....	72	7.8	31	**8**
9	....	.8	.8	4.1	8.9	9.7	4.9	9.7	**20.3**	4.1	10.6	9.8	6.5	3.3	3.3	1.6	.8	....	.8	....	....	....	....	....	....	....	123	10.2	29	**9**
10	....	.6	.6	1.2	5.	6.2	6.9	7.5	**16.3**	10.7	9.4	7.5	10.7	6.9	1.2	2.5	3.8	1.2	1.2	....	....	....	....	....	....	....	160	9.5	31	**10**
11	1.3	2.7	2.7	5.3	**20.1**	9.3	9.3	6.7	13.4	13.4	4.	5.3	1.3	1.3	1.3	1.3	1.3	....	....	....	....	....	....	....	....	....	75	5.8	38	**11**
12	....	....	4.9	5.8	6.8	6.8	8.7	**17.4**	13.6	**17.4**	6.8	4.9	2.9	1.	1.	1.	....	....	....	1.	....	....	....	....	....	....	103	7.8	29	**12**
13	....	....	....	4.5	4.5	7.5	7.5	**13.3**	10.4	9.	10.4	10.4	7.5	3.	4.5	4.5	....	3.	....	....	....	....	....	....	....	....	67	9.7	29	**13**
14	....	1.3	....	7.5	10.	6.3	13.7	**14.9**	7.5	10.	12.4	6.3	3.8	....	....	3.8	2.5	....	....	....	....	....	....	....	....	....	80	9.3	34	**14**
15	1.2	.6	3.	4.8	**12.5**	6.	6.6	11.9	9.6	7.8	10.2	7.2	5.4	4.8	4.2	1.2	.6	1.2	1.2	....	....	....	....	....	....	....	167	8.6	37	**15**
16	1.4	1.4	4.2	9.7	8.3	**12.4**	9.7	5.6	8.3	5.6	11.1	4.2	6.9	4.2	....	2.8	4.2	....	....	....	....	....	....	....	....	....	72	7.5	45	**16**
17	....	1.5	4.5	3.	4.5	9.	6.	**16.3**	13.3	6.	11.9	3.	9.	3.	3.	3.	3.	....	....	....	....	....	....	....	....	....	67	8.4	33	**17**
18	....	....	1.9	5.6	9.3	5.6	3.6	7.4	**18.4**	3.7	9.2	14.7	5.6	1.9	1.9	9.3	1.9	....	....	....	....	....	....	....	....	....	54	9.7	27	**18**
19	....	....	1.6	1.6	4.9	8.2	**13.**	9.8	8.2	9.8	8.2	11.6	8.1	1.6	9.8	1.6	....	....	....	....	1.6	....	....	....	....	....	61	9.1	37	**19**
20	....	....	1.8	8.9	8.9	5.4	5.4	**23.2**	8.9	7.1	8.9	1.8	7.1	5.4	3.6	1.8	....	....	....	....	1.8	....	....	....	....	....	56	8.5	30	**20**
Total..	.26	.85	2.02	4.56	9.11	7.07	7.18	12.3	**12.56**	9.	9.64	7.34	6.86	3.19	2.93	2.07	1.54	.48	.48	.16	.21	....	.05	....	....	....	1,879	8.5	35	

TABLE XXV

City Distributions—Seventh Grade—Division: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	3.2	3.2	2.4	3.2	6.4	7.3	4.9	11.4	**12.9**	9.8	9.8	8.1	3.9	3.9	3.2	1.6	.8	1.6	.8	**1.6**	...	...	...	...	...	...	124	8.6	35	**1**
2	5.1	8.5	8.5	8.5	**15.2**	8.5	8.5	**15.2**	3.4	10.1	1.7	3.4	1.7	...	1.7	...	...	...	...	...	...	...	...	...	...	...	59	5.6	50	**2**
3	.8	.8	2.4	6.	7.6	8.4	11.8	11.1	**14.7**	9.2	6.4	8.4	5.6	1.6	1.6	1.6	.8	.4	.8	...	...	...	...	...	...	...	251	8.1	35	**3**
4	4.2	4.2	2.8	**15.4**	11.3	12.7	11.3	**15.4**	2.8	2.8	5.6	2.8	4.2	1.5	1.5	...	1.5	...	...	...	...	...	...	...	...	...	71	6.	41	**4**
5	3.3	6.7	6.7	...	8.3	**11.6**	6.7	6.7	10.	8.3	5.	3.3	3.3	5.	3.3	1.7	3.3	1.7	1.7	1.7	...	...	1.7	...	...	...	60	8.	49	**5**
6	1.6	10.7	9.1	**16.3**	10.6	7.4	9.1	9.1	9.7	4.1	4.1	4.1	.8	2.5	.8	...	...	...	...	...	...	...	...	...	...	...	122	5.3	31	**6**
7	8.3	2.8	2.8	11.1	2.8	**16.6**	5.6	2.8	13.8	2.8	13.8	2.8	2.8	5.6	2.8	2.8	...	...	...	...	...	...	...	...	...	...	36	5.7	47	**7**
8	5.6	4.2	2.8	9.7	11.1	8.3	**18.**	11.1	5.6	8.3	8.3	1.4	4.2	1.4	...	...	...	...	...	...	...	...	...	...	...	...	72	6.5	43	**8**
9	3.3	4.1	9.0	7.3	5.7	7.3	10.5	9.0	**13.7**	5.7	10.6	1.6	4.9	2.4	3.3	...	.8	...	.8	...	...	...	...	...	...	...	123	7.1	37	**9**
10	1.3	5.1	1.3	5.1	7.5	9.3	9.3	10.	11.8	**12.4**	5.6	6.3	5.6	2.5	1.3	1.9	1.9	.6	.6	...	...	...	...	...	.6	...	160	8.1	37	**10**
11	10.7	9.3	6.7	14.6	**16.**	7.9	7.9	7.9	4.2	4.2	2.7	1.3	1.3	2.7	1.3	1.3	...	...	...	...	...	...	...	...	...	...	75	5.2	53	**11**
12	1.9	2.9	8.7	7.8	9.7	7.8	11.7	**15.4**	11.7	7.8	6.8	3.8	1.	1.	1.	...	...	1.	...	...	...	...	...	...	...	...	103	6.6	40	**12**
13	...	4.5	5.9	10.4	7.5	5.9	10.4	**13.6**	12.	7.5	4.5	5.9	5.9	3.	3.	...	...	...	...	...	...	...	...	...	...	...	67	8.6	39	**13**
14	2.5	5.1	10.	6.3	12.4	**13.7**	12.4	7.4	8.8	10.	5.1	...	2.5	...	...	3.8	...	...	...	...	...	...	...	...	...	...	80	6.5	45	**14**
15	6.6	5.4	9.6	6.6	7.8	5.4	7.2	**11.3**	10.1	6.6	7.8	5.4	2.4	1.8	2.4	1.8	.6	1.2	...	...	...	...	...	...	...	...	167	7.1	52	**15**
16	8.3	12.5	9.7	4.2	**19.5**	4.2	6.8	4.2	5.6	4.2	5.6	2.8	6.8	...	...	2.8	2.8	...	...	...	...	...	...	...	...	...	72	4.8	48	**16**
17	7.5	5.9	10.4	13.5	7.5	4.5	3.0	**16.5**	5.9	5.9	5.9	4.5	1.5	3.0	3.0	1.5	...	...	...	...	...	...	...	...	...	...	67	6.8	60	**17**
18	3.7	1.9	9.3	5.6	11.	7.4	11.	**14.7**	5.6	7.4	5.6	3.7	1.9	1.9	3.7	5.6	...	...	...	...	...	...	...	...	...	...	54	7.1	48	**18**
19	6.6	4.9	3.3	1.6	1.6	**14.7**	11.5	11.5	8.2	11.5	8.2	3.3	8.2	1.6	3.3	...	...	...	...	...	...	...	...	...	...	...	61	7.5	36	**19**
20	7.1	5.3	8.9	10.7	3.6	**10.8**	**10.8**	8.9	10.7	7.1	3.6	5.3	3.6	...	1.8	...	...	...	...	...	1.8	...	...	...	...	...	56	7.1	40	**20**
Total..	3.67	8.57	5.96	7.61	9.26	8.3	9.42	**10.74**	10.06	7.93	6.65	4.47	3.83	2.23	1.81	1.43	.69	.42	.32	.16	.05	...	.05	...	...	...	1,880	6.7	46	

TABLE XXVI

City Distributions—Eighth Grade—Addition: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	....	....	....	.9	1.9	....	4.6	13.2	14.2	**16.1**	14.2	11.3	6.6	3.8	.9	2.8	3.8	1.9	1.9	1.9	....	....	....	....	....	....	106	11.9	19	**1**
2	....	....	....	....	....	17.2	17.2	**20.**	**20.**	8.6	11.4	....			....	2.9	....	2.9	....	....	....	....	....	....	....	....	35	9.9	23	**2**
3	....	....	....	1.1	3.2	6.4	11.2	11.7	**23.4**	15.4	11.2	8.0	2.7	3.2	.5	1.5	....	....	....	.5	....	....	....	....	....	....	188	10.	20	**3**
4	....	1.6	4.8	4.8	12.4	**15.7**	14.1	10.8	10.8	14.1	1.6	3.1	3.1	3.1	....	....	....	....	....	....	....	....	....	....	....	....	64	7.8	27	**4**
5	....	....	....	....	8.6	12.1	**15.2**	8.6	12.1	12.1	12.1	10.6	....	4.3	....	....	....	....	....	....	....	....	....	....	....	....	46	10.1	24	**5**
6	....	....	1.	1.	3.	6.1	17.2	13.2	15.2	**19.3**	6.1	7.1	4.1	1.	2.	2.	1.	....	....	....	....	....	....	....	....	....	99	9.4	23	**6**
7	....	....	....	....	....	3.3	26.7	13.4	**30.1**	10.	6.6	3.3	3.3	....	....	....	3.3	....	....	....	....	....	....	....	....	....	30	9.	27	**7**
8	....	....	....	....	1.8	6.9	6.9	17.2	6.9	**22.4**	10.3	10.3	10.3	5.2	1.8	....	....	....	....	....	....	....	....	....	....	....	58	9.9	29	**8**
9	....	....	....	....	1.	2.	10.	12.1	**17.2**	12.1	13.1	11.1	4.1	4.1	4.1	1.	6.1	1.	....	....	....	1.	....	....	1.	....	99	11.4	22	**9**
10	....	....	....	....	....	.8	6.6	11.5	10.8	13.1	**16.4**	11.5	10.7	4.1	3.3	.8	.8	1.6	....	....	....	....	....	....	....	....	122	11.	22	**10**
11	....	....	....	....	2.9	5.9	9.6	16.8	**20.5**	20.0	11.1	3.7	2.9	2.9	1.5	2.2	....	....	....	....	....	....	....	....	....	....	136	10.	25	**11**
12	....	....	....	....	7.5	4.5	7.5	9.1	15.2	**16.8**	9.1	9.1	3.	3.	....	....	....	....	....	....	....	....	....	....	....	....	66	10.1	22	**12**
13	....	....	....	....	....	1.7	15.3	18.6	**16.9**	**16.9**	11.9	10.2	5.1	1.7	....	1.7	....	....	....	....	....	....	....	....	....	....	59	11.5	19	**13**
14	....	....	....	....	1.4	4.1	10.8	**17.5**	14.8	13.6	**17.5**	5.4	9.4	1.4	2.7	1.4	....	....	....	....	....	....	....	....	....	....	74	10.	23	**14**
15	....	....	....	1.6	2.4	6.5	11.5	12.1	17.9	**18.5**	7.3	8.9	4.9	1.6	1.6	.9	1.6	.9	....	....	....	....	....	.9	.9	....	124	9.4	30	**15**
16	....	....	....	....	3.1	6.3	17.2	9.4	**21.9**	12.5	10.8	9.4	1.6	3.1	3.1	....	....	....	....	....	....	1.6	....	....	....	....	64	10.6	19	**16**
17	....	....	....	....	....	3.1	7.8	10.9	10.9	**14.1**	10.9	**14.1**	12.5	7.8	6.3	....	1.6	....	....	....	....	....	....	....	....	....	64	10.7	25	**17**
18	....	....	....	1.5	....	7.7	4.6	**16.9**	15.4	15.4	15.4	10.8	3.1	3.1	....	3.1	1.5	1.5	....	....	....	....	....	....	....	....	65	10.	26	**18**
19	....	....	1.1	1.1	....	5.4	4.3	**21.4**	10.7	19.4	17.2	6.4	4.3	4.3	2.2	1.1	1.1	....	....	....	....	....	....	....	....	....	93	10.1	21	**19**
20	....	....	....	3.6	3.6	7.3	14.5	10.9	**27.4**	16.4	10.9	....	1.8	1.8	1.8	....	....	....	....	....	....	....	....	....	....	....	55	11.1	21	**20**
Total..	....	.06	.3	.79	2.65	15.53	10.6	13.66	**17.31**	15.96	11.81	8.11	5.1	3.1	1.83	1.22	1.1	.49	.12	.18	....	.12	....	.06	.12	....	1,647	10.2	25	

TABLE XXVII

City Distributions—Eighth Grade—Addition: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	.9	2.9	7.6	4.6	11.3	9.4	**13.3**	11.3	9.4	9.4	3.8	2.9	3.8	.9	1.9	1.9	2.9	.9			.9						106	7.2	41	**1**
2	5.7	8.6	14.3	17.1	**22.7**	11.4	2.9	8.6	2.9	2.9			2.9														35	4.3	47	**2**
3	1.1	3.2	10.	7.4	13.2	12.7	**14.7**	13.1	10.	9.6	2.2	1.6	.5	1.6	.5												188	6.2	39	**3**
4			17.3	12.5	**23.3**	17.3	12.4	4.7	4.7	1.6	3.1		3.1														64	4.8	34	**4**
5			13.1	11.8	15.2	8.7	**17.4**	11.8	11.8	6.6	4.4			2.2													46	6.1	41	**5**
6	2.	4.1	12.1	10.1	11.1	10.1	**19.1**	13.2	7.1	4.1	2.	2.		2.		1.											99	6.	39	**6**
7	6.6	6.6	6.6	20.2	13.5	3.3	**23.4**	6.6	6.6		3.3				3.3												30	4.7	51	**7**
8	1.8	12.1	13.3	8.5	**15.4**	12.1	12.1	12.1	3.4		5.2	1.8		1.8													58	4.9	54	**8**
9	2.	3.	4.1	13.1	**18.2**	14.1	15.2	9.1	6.1	5.1	2.	2.	1.		2.			2.	1.								99	5.8	39	**9**
10	.9	.9	4.9	9.0	9.0	17.9	**13.9**	9.0	7.5	10.7	9.0	3.3		.8	1.6	1.6											122	6.5	39	**10**
11	2.2	4.5	9.7	**16.2**	13.2	13.9	8.1	11.9	10.3	7.5	1.6	.9															136	5.5	47	**11**
12	1.5		4.5	6.2	13.7	13.7	9.2	**22.7**	7.5	7.5	4.5	4.5	3.		1.5												66	7.1	32	**12**
13		3.4	6.2	10.2	**15.3**	8.4	8.4	13.6	11.9	10.2	5.1	3.4	1.7	1.7													59	6.9	42	**13**
14	6.8	4.1	6.8	12.1	**14.7**	13.6	10.7	10.7	6.8	5.4	4.1	1.4		1.4	1.4												74	5.6	50	**14**
15	1.6	4.1	5.7	16.3	15.4	10.6	**17.1**	8.8	6.5	4.1	3.3	.8	1.6	1.6		.8				.8		.8					123	5.8	43	**15**
16	4.7	12.5	9.4	7.8	**17.2**	10.7	14.1	12.5	1.6	6.3		1.6				1.6											64	4.1	63	**16**
17	7.8	6.3	9.4	3.1	**17.2**	12.5	12.5	7.8	10.8	4.7	4.7		1.6		1.6												64	5.6	48	**17**
18	1.5	3.	4.4	6.2	**18.2**	16.8	15.2	6.2	9.1	6.1	4.4	4.4	3.	1.5													66	6.1	38	**18**
19	1.1	4.3	10.7	**19.5**	10.7	10.7	11.9	8.6	7.5	7.5	4.3		3.2														93	5.1	47	**19**
20		9.1	7.31	10.9	10.9	18.2	**23.6**	7.3	1.8	5.5	1.8	1.8		1.8													55	5.7	34	**20**
Total..	2.07	4.13	8.54	10.9	**14.33**	12.7	13.72	10.8	7.47	6.47	3.46	1.7	1.22	.91	.67	.43	.18	.18	.06	.06	.06	.06					1,647	5.8	41	

3—3102

TABLE XXVIII

City Distributions—Eighth Grade—Subtraction: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	....	....	....	....	....	....	1.9	.9	2.8	8.5	9.5	**11.4**	9.5	**11.4**	9.5	5.6	7.5	10.4	.9	1.9	2.8	2.8	.9	.9	.9	....	106	13.4	22	**1**
2	....	....	....	....	....	2.9	5.7	5.7	11.4	**22.8**	11.4	8.6	8.6	5.7	11.4	....	....	....	....	2.9	....	2.9	....	....	....	....	35	10.3	23	**2**
3	....	....	....	....	....	1.1	2.7	3.7	9.5	**16.4**	12.7	17.1	11.2	9.6	6.9	2.2	1.6	2.2	.5	1.1	.5	.5	.5	....	....	....	188	11.2	21	**3**
4	....	....	17.3	12.4	**23.3**	17.4	12.4	4.7	4.7	1.6	3.1	....	3.1	....	....	....	....	....	....	....	....	....	....	....	....	....	64	8.7	21	**4**
5	....	....	....	....	....	2.2	4.4	6.5	10.8	**23.8**	13.1	10.8	6.5	8.7	2.2	2.2	4.4	2.2	....	2.2	....	....	....	....	....	....	46	10.2	21	**5**
6	....	....	....	....	2.0	....	4.1	5.1	14.1	**18.2**	17.1	17.1	8.1	4.1	5.1	1.0	1.0	....	....	2.0	....	1.	....	....	....	....	99	10.4	19	**6**
7	....	....	....	....	....	3.3	3.3	6.5	10.1	20.1	**23.4**	3.3	6.5	16.6	....	....	3.3	....	3.3	....	....	....	....	....	....	....	30	10.3	21	**7**
8	....	....	....	....	1.8	....	5.2	3.4	**15.5**	10.4	**15.5**	5.2	8.5	20.7	3.4	3.4	5.2	....	....	1.8	....	....	....	....	....	....	58	11.	24	**8**
9	....	....	....	....	....	2.0	1.0	5.2	5.2	16.3	**17.3**	13.3	7.1	9.2	7.1	3.1	.1	3.1	1.	1.	3.1	1.	....	1.	.2	....	98	12.2	23	**9**
10	....	....	....	....	....	....	....	3.3	4.9	14.8	**17.3**	13.9	9.8	9.0	5.7	4.9	8.2	2.5	3.3	.8	....	....	.8	....	....	....	122	11.87	21	**10**
11	....	....	....	....	.7	....	2.2	5.8	14.0	**17.6**	13.2	14.0	8.9	4.4	7.4	3.7	2.2	2.2	2.2	1.5	....	....	....	....	....	....	136	10.9	22	**11**
12	....	....	....	....	....	....	....	3.0	12.1	**18.2**	16.7	9.1	**18.2**	10.6	7.6	3.	....	1.5	....	....	....	....	....	....	....	....	66	11.3	20	**12**
13	....	....	....	....	....	....	....	5.1	5.1	10.2	**18.6**	16.9	**18.6**	10.1	1.7	3.4	6.8	1.7	....	1.7	....	....	....	....	....	....	59	11.6	17	**13**
14	....	....	....	....	....	....	....	1.4	4.1	**21.5**	12.2	12.2	9.4	13.4	8.1	6.8	5.4	2.7	1.4	1.4	....	....	....	....	....	....	74	10.6	21	**14**
15	....	....	....	....	....	1.6	6.5	10.6	**14.5**	9.6	13.7	11.2	8.1	10.6	5.6	1.6	2.4	....	1.6	....	.8	....	....	1.6	....	....	124	10.7	24	**15**
16	....	....	....	....	....	....	....	6.2	7.8	14.1	12.5	**18.7**	14.1	4.7	12.5	....	....	4.7	3.1	....	1.6	....	....	....	....	....	64	11.5	20	**16**
17	....	....	....	....	....	1.6	....	4.7	9.4	3.1	**21.8**	15.6	10.9	9.4	3.1	4.7	4.7	3.1	1.6	3.1	....	1.6	1.6	....	....	....	64	11.6	21	**17**
18	....	....	....	....	....	....	1.5	1.5	1.5	7.7	9.3	12.3	10.8	**13.9**	**13.9**	4.6	4.6	4.6	3.1	3.1	4.6	1.5	....	....	1.5	....	65	13.	21	**18**
19	....	....	....	....	....	1.1	....	....	12.	16.3	**21.7**	14.1	10.9	9.7	5.4	2.2	1.1	1.1	1.1	....	2.2	....	1.1	....	....	....	92	11.	19	**19**
20	....	....	....	....	....	....	....	7.2	7.2	**12.8**	11.	**12.8**	**12.8**	11.	5.4	3.6	7.2	7.2	....	....	1.8	....	....	....	....	....	55	12.	22	**20**
Total..	....	....	.67	.48	1.16	1.34	2.44	4.44	8.95	14.12	**14.42**	12.84	10.05	9.27	6.41	2.99	3.29	2.56	1.22	1.16	.91	.55	.3	.24	.3	....	1,644	11.2	22	

TABLE XXIX

City Distributions—Eighth Grade—Subtraction: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1			1.0	1.9	2.8	3.8	4.7	4.7	11.3	5.7	11.3	**13.2**	7.5	11.3	2.8	1.9	7.5	1.	2.8	2.8		1.0		1.			106	11.3	27	**1**
2			2.9	8.7	5.7	8.7	8.7	**19.1**	8.7	11.5	8.7	2.9	5.7	2.9	2.9		2.9										35	7.9	34	**2**
3			.5	1.6	2.7	2.7	10.1	8.5	**20.2**	11.7	13.4	11.1	6.4	3.7	3.7		.5	3.2									188	9.3	24	**3**
4		3.2	1.6	1.6	3.2	12.5	13.9	**21.7**	10.8	9.4	12.5	3.2	3.2	1.6	1.6												64	7.7	28	**4**
5		2.2		2.2	8.7	2.2	4.3	15.2	11.9	**21.8**	13.	6.5	4.3			2.2	2.2	4.3									46	9.2	24	**5**
6		2.0	4.0	2.0	4.0	12.1	13.2	12.1	**18.3**	12.1	6.1	6.1	3.0	1.0	1.0	1.0	1.0				1.0						99	8.	29	**6**
7		3.3		3.3	10.	3.3	13.3	**20.1**	13.3	13.3	6.7	6.7	6.7														30	7.8	27	**7**
8	1.7	1.7	3.4	13.7	6.8	6.8	5.1	6.8	**17.2**	14.0	3.4	6.8	5.1		3.4	3.4			1.7								58	8.1	40	**8**
9		1.0	2.0	4.1	5.1	8.2	6.1	10.2	**17.4**	12.2	9.2	7.1	4.1	3.1	4.1	1.0	1.0		3.1				1.0				98	8.8	32	**9**
10			.8	.8	.8	6.6	9.8	12.3	10.7	**14.0**	9.0	9.0	9.0	4.1	3.3	3.3	3.3	1.6	.8			.8					122	9.6	29	**10**
11		.7	2.2	.7	8.2	9.7	9.7	11.9	**14.0**	12.5	10.4	6.7	5.1	5.1	2.2	.7											136	8.9	30	**11**
12				1.5			7.6	12.1	**16.7**	12.1	13.6	13.6	15.3	4.5	1.5		1.5										66	10.	22	**12**
13				1.7		5.1	8.5	10.1	**18.7**	11.8	11.8	13.5	6.9			5.1	5.1	1.7									59	9.6	25	**13**
14			2.7	1.4	4.1	10.9	12.2	6.9	**12.3**	**12.3**	4.1	7.1	9.6	6.9	2.7	2.7	2.7	1.4									74	8.8	35	**14**
15	1.6	2.4	.8	6.5	7.3	7.3	**14.9**	**14.9**	7.3	9.0	11.5	7.3	3.2	3.2	.8	1.6			.8		.8	.8					123	8.	30	**15**
16			1.6	3.1	13.9	7.8	3.1	**12.4**	**12.4**	9.4	10.9	7.8	7.8	6.2			1.6	1.6									64	8.6	36	**16**
17		1.6	4.7	4.7	10.9	10.9	6.2	**18.7**	6.2	4.7	4.7	9.4	4.7	4.7	1.6	1.6	3.1				1.6						64	7.7	43	**17**
18			1.5	1.5	1.5	1.5	4.6	9.3	7.7	7.7	**18.6**	10.8	6.2	10.8	4.6	6.2	1.5	1.5	1.5	1.5			1.5				65	11.	27	**18**
19			1.1	2.2	6.5	8.6	13.	14.	**15.1**	9.7	6.5	11.9	4.3	2.2		1.1	2.2		1.1	1.1							93	8.9	28	**19**
20				1.8	1.8	3.6	9.1	14.6	9.1	10.9	**16.4**	10.9	3.6	3.6	3.6	3.7	5.5	1.8									55	9.9	25	**20**
Total..	2.4	.79	1.52	2.86	4.86	6.61	9.2	11.86	**13.5**	11.02	10.23	8.96	6.04	4.07	2.19	1.64	1.95	.97	.67	.3	.18	.18	.12	.06			1,645	8.9	31	

TABLE XXX

City Distributions—Eighth Grade—Multiplication: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	....	....	....	....	....	1.9	1.9	5.6	10.4	8.6	10.4	8.6	**19.8**	12.3	5.6	5.6	5.6	....	....	2.8	.9	....	....	....	....	....	106	11.9	19	**1**
2	....	....	....	....	....	5.6	8.6	8.6	8.6	**22.8**	14.2	8.6	2.9	8.6	8.6	....	....	....	....	....	....	2.9	....	....	....	....	35	9.9	23	**2**
3	....	....	....	....	1.1	2.2	5.3	11.2	11.2	**19.6**	18.6	13.2	6.8	2.7	2.7	1.6	1.6	1.1	....	1.1	....	....	....	....	....	....	188	10.	20	**3**
4	....	....	....	1.6	4.8	7.9	**23.8**	15.9	7.9	9.5	15.9	11.1	....	....	....	1.6	....	....	....	....	....	....	....	....	....	....	63	7.8	27	**4**
5	....	....	....	....	....	2.2	8.7	10.8	10.8	15.2	**17.4**	8.7	8.7	8.7	2.2	4.4	....	2.2	....	....	....	....	....	....	....	....	46	10.1	24	**5**
6	....	....	....	2.	2.	4.1	7.1	**16.2**	12.	**16.2**	**16.2**	11.	6.1	5.1	....	1.	....	1.	....	....	....	....	....	....	....	....	99	9.4	23	**6**
7	....	....	....	....	....	6.6	6.6	13.4	**23.4**	6.6	13.4	20.1	3.3	6.6	....	....	....	....	....	....	....	....	....	....	....	....	30	9.	27	**7**
8	....	....	....	1.8	1.8	6.9	10.3	13.8	6.9	10.3	8.6	**15.4**	10.3	6.9	3.5	3.5	....	....	....	....	....	....	....	....	....	....	58	9.9	29	**8**
9	....	....	....	....	....	....	5.1	7.1	9.2	10.2	**17.4**	7.1	14.4	6.1	6.1	5.1	6.1	3.1	....	2.	1.	....	....	....	....	....	98	11.4	22	**9**
10	....	....	....	....	1.6	3.3	1.6	5.7	9.0	11.5	16.4	**19.8**	5.7	9.0	6.6	3.3	....	2.5	.8	1.6	1.6	....	....	....	....	....	122	11.	22	**10**
11	....	....	....	2.2	.9	2.2	9.7	11.1	9.7	14.7	**16.8**	8.8	8.8	5.2	5.9	1.6	1.6	.9	.9	....	....	....	....	....	....	....	136	10.	25	**11**
12	....	....	....	....	....	6.2	6.2	12.1	13.6	4.5	**19.7**	15.2	7.4	7.4	1.5	6.2	....	....	....	....	....	....	....	....	....	....	66	10.1	22	**12**
13	....	....	....	....	....	1.7	1.7	8.5	8.5	10.2	13.5	13.5	**20.2**	8.5	10.2	1.7	....	1.7	....	....	....	....	....	....	....	....	59	11.5	19	**13**
14	....	....	....	....	....	4.1	8.1	10.7	8.1	**21.7**	12.1	13.6	10.7	5.4	1.4	1.4	2.7	....	....	....	....	....	....	....	....	....	74	10.	23	**14**
15	....	....	....	2.3	1.6	4.1	**19.5**	7.3	13.9	8.8	11.5	12.1	6.5	2.4	3.3	4.1	.8	....	.8	....	....	....	....	....	....	....	123	9.4	30	**15**
16	....	....	....	1.5	....	1.5	6.0	11.8	9.0	13.4	13.4	**25.4**	3.0	4.5	1.5	6.0	....	1.5	....	1.5	....	....	....	....	....	....	67	10.6	19	**16**
17	....	....	....	....	....	7.8	3.1	4.7	18.7	3.1	**18.8**	10.8	9.4	6.3	4.7	6.3	3.1	....	....	1.6	1.6	....	....	....	....	....	64	10.7	25	**17**
18	....	....	....	3.1	....	3.1	6.2	4.6	12.3	**18.5**	13.8	9.2	7.7	12.3	6.2	1.5	1.5	....	....	....	....	....	....	....	....	....	65	10.	26	**18**
19	....	....	....	....	....	1.1	8.6	12.9	10.7	**16.1**	11.9	10.7	11.8	8.6	2.2	1.1	2.2	....	....	2.2	....	....	....	....	....	....	93	10.1	21	**19**
20	....	....	....	1.8	....	3.6	5.5	14.6	3.6	14.6	12.7	3.6	10.9	**16.4**	7.3	1.8	1.8	1.8	....	....	....	....	....	....	....	....	55	11.1	21	**20**
Total..	....	....	....	.91	.79	3.34	7.62	10.13	10.74	13.19	**14.94**	12.3	9.03	6.65	10.6	2.93	1.58	.85	.18	.79	.3	.06	....	....	....	....	1,647	10.2	25	

TABLE XXXI

City Distribution—Eighth Grade—Multiplication: Rights. Per Cent of Children Making Each Score

CITY	Score																										Total Number of Children	Median Score	Per Cent Variability	CITY
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25				
1	...	.9	1.9	.9	6.7	2.8	12.2	**15.2**	13.3	9.4	9.4	10.4	7.6	1.9	3.8	.9	.9	.9	...	.9	...	...	...	...	...	...	106	9.	28	**1**
2	...	2.9	5.7	8.6	5.7	14.2	14.2	**20.0**	2.9	5.7	5.7	2.9	2.9	5.7	...	2.9	...	...	...	...	...	...	...	...	...	...	35	7.	39	**2**
3	.5	.5	1.1	2.2	7.4	9.6	14.4	**20.2**	17.1	8.5	6.7	4.3	3.7	1.6	1.1	1.1	...	...	...	...	...	...	...	...	...	...	188	7.7	25	**3**
4	...	...	1.6	...	9.7	20.9	**22.7**	20.9	6.5	11.3	3.2	3.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	62	6.6	26	**4**
5	...	...	...	...	13.2	10.8	**17.4**	10.8	8.7	10.8	10.8	6.6	...	8.7	...	2.2	...	...	...	...	...	...	...	...	...	...	46	7.8	33	**5**
6	1.0	3.	5.2	8.1	9.1	10.1	**19.1**	14.1	16.2	8.1	2.0	...	2.0	1.0	...	...	1.0	...	...	...	...	...	...	...	...	...	99	6.8	34	**6**
7	...	...	6.6	10.	16.7	13.3	16.7	...	**20.1**	13.3	3.3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30	6.2	40	**7**
8	5.2	1.8	5.2	**15.4**	13.8	12.1	8.5	3.5	6.9	8.5	12.1	5.2	1.8	...	...	...	...	...	...	...	...	...	...	...	...	...	58	5.5	53	**8**
9	...	1.0	1.0	2.0	**13.3**	4.1	**13.3**	10.2	12.3	11.2	**13.3**	3.1	6.1	5.1	1.0	1.0	2.0	...	...	...	...	...	...	...	...	...	98	8.5	33	**9**
10	...	.8	2.5	5.7	5.7	7.4	15.6	13.9	16.4	**16.7**	5.7	5.7	2.5	2.5	.8	1.6	...	2.5	...	...	...	...	...	...	...	...	122	7.9	28	**10**
11	1.5	2.9	2.9	11.	10.2	**18.2**	16.8	9.5	10.2	3.7	5.8	1.5	4.4	...	.7	.7	...	...	...	...	...	...	...	...	...	...	137	6.2	36	**11**
12	...	...	3.	4.5	3.	12.1	13.7	9.1	**15.2**	12.1	13.7	7.6	3.0	3.0	...	...	...	...	...	...	...	...	...	...	...	...	66	8.2	30	**12**
13	1.7	...	5.1	...	1.7	6.8	13.5	8.5	10.1	10.1	**18.7**	11.9	6.8	1.7	1.7	...	...	1.7	...	...	...	...	...	...	...	...	59	9.3	29	**13**
14	2.7	1.4	6.8	4.1	12.1	4.1	**18.9**	12.1	8.1	14.7	5.4	4.1	...	1.4	4.1	...	...	...	...	...	...	...	...	...	...	...	74	7.5	38	**14**
15	2.5	5.7	4.1	9.8	10.7	**12.1**	11.2	11.2	**12.1**	7.5	4.9	3.3	1.6	2.5	...	.8	...	...	...	...	...	...	...	...	...	...	123	6.5	41	**15**
16	1.5	1.5	...	7.6	7.6	10.5	1.8	**13.6**	7.6	7.5	11.9	7.5	4.5	...	...	...	1.5	...	...	...	...	...	...	...	...	...	67	7.3	37	**16**
17	7.8	1.6	4.7	9.4	7.8	**12.5**	**12.5**	10.8	7.8	9.4	4.7	7.8	1.6	...	1.6	...	...	...	...	...	...	...	...	...	...	...	64	6.4	41	**17**
18	...	4.7	1.5	4.5	10.8	4.7	14.1	**16.7**	12.6	9.2	6.1	6.1	6.1	1.5	1.5	...	...	...	...	...	...	...	...	...	...	...	65	7.8	32	**18**
19	2.1	1.1	4.3	6.4	10.8	**22.6**	7.5	10.8	10.8	7.5	10.8	2.1	3.2	...	...	...	...	...	...	...	...	...	...	...	...	...	93	6.7	36	**19**
20	...	...	5.6	1.9	7.4	14.8	**20.3**	13.	1.9	13.	9.2	1.9	11.	...	...	...	...	...	...	...	...	...	...	...	...	...	54	7.7	30	**20**
Total..	1.28	1.64	3.1	5.53	8.96	10.96	**14.76**	12.94	11.75	9.2	7.93	4.62	3.58	1.7	.91	.61	.37	.3	...	.06	...	...	...	...	...	...	1,647	7.3	34	

TABLE XXXII

City Distributions—Eighth Grade—Division: Attempts. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	....	....	....	....	....	.9	1.9	3.8	3.8	8.5	6.7	3.8	12.3	**13.2**	7.6	**13.2**	10.4	7.6	5.7	.9	....	....	....	....	....	....	106	13.7	21	**1**
2	....	....	2.9	2.9	5.7	....	2.9	**17.1**	**22.8**	5.7	11.3	2.9	5.7	2.9	2.9	5.7	5.7	....	....	....	....	....	....	....	2.9	....	35	8.9	27	**2**
3	....	.5	1.6	....	5.3	7.4	12.8	8.5	11.7	9.2	**13.9**	7.4	7.9	4.8	2.7	3.2	1.6	.5	.5	....	.5	....	....	....	....	....	188	11.2	27	**3**
4	....	....	....	1.6	3.2	1.6	14.2	**19.1**	9.5	7.9	12.7	3.2	14.2	4.8	....	4.8	1.6	1.6	....	....	....	....	....	....	....	....	63	9.2	24	**4**
5	....	....	....	....	6.5	4.3	4.3	**23.9**	2.2	6.5	4.3	13.1	13.1	6.5	6.5	2.2	2.2	2.2	2.2	....	....	....	....	....	....	....	46	10.5	32	**5**
6	....	1.	2.	4.	6.1	3.	6.1	**15.2**	12.1	9.1	11.1	9.1	9.1	7.1	1.	2.	....	2.	....	....	....	....	....	....	....	....	99	9.4	29	**6**
7	....	....	....	....	3.4	10.	3.4	10.	**16.6**	6.6	3.4	**16.6**	**16.6**	....	3.4	10.	....	....	....	....	....	....	....	....	....	....	30	10.	27	**7**
8	....	....	1.7	3.5	12.1	6.9	3.5	10.3	**13.7**	3.5	3.5	6.9	8.5	12.1	5.2	6.9	1.7	....	....	....	....	....	....	....	....	....	58	9.4	40	**8**
9	....	....	....	3.	5.1	5.1	6.1	9.	8.1	**14.1**	5.1	7.1	10.1	6.1	2.	4.	7.1	1.	3.	2.	....	....	....	....	2.	....	99	10.4	34	**9**
10	....	....	....	.8	.8	....	3.3	5.7	7.4	9.1	9.9	4.9	12.3	**14.8**	4.9	5.7	6.6	4.1	4.1	1.6	2.5	....	....	1.6	....	....	122	12.7	25	**10**
11	....	....	3.	10.7	5.3	1.5	11.4	10.7	9.6	**15.2**	6.1	8.3	2.3	4.6	5.3	3.8	....	.8	....	.8	....	....	....	.8	....	....	132	9.7	32	**11**
12	....	....	....	....	6.1	3.	4.6	**18.1**	6.1	4.6	15.1	3.	12.1	9.1	7.5	4.6	6.1	....	....	....	....	....	....	....	....	....	66	10.5	32	**12**
13	....	....	....	1.7	3.4	5.1	1.7	8.5	11.8	5.1	8.5	5.1	**15.2**	**15.2**	1.7	6.8	5.1	1.7	3.4	....	....	....	....	....	....	....	59	11.3	23	**13**
14	....	....	....	5.4	1.4	2.7	2.7	**16.2**	13.5	10.8	6.8	8.2	10.8	6.8	4.1	8.2	2.7	....	....	....	....	....	....	....	....	....	74	9.9	31	**14**
15	.8	....	.8	4.9	8.1	1.6	6.5	**12.2**	8.9	8.9	9.8	11.4	7.4	4.9	2.4	7.4	1.6	.8	....	....	1.6	....	....	....	....	....	123	9.9	33	**15**
16	1.5	....	....	....	3.	1.5	7.5	6.	**19.3**	14.8	9.	6.	4.4	9.	6.	3.	3.	3.	1.5	....	....	....	1.5	....	....	....	67	9.8	27	**16**
17	....	....	1.6	1.6	4.7	7.8	4.7	**10.8**	9.4	7.8	**10.8**	6.3	4.7	3.1	9.4	3.1	6.3	4.7	1.6	....	1.6	....	....	....	....	....	64	10.3	33	**17**
18	....	1.5	....	3.1	3.1	....	4.5	7.7	7.7	6.2	6.2	6.2	**15.4**	7.7	7.7	3.1	6.2	4.5	....	3.1	1.5	3.1	....	....	1.5	....	65	11.9	26	**18**
19	1.1	....	....	2.2	2.2	5.3	5.3	4.3	10.8	**13.8**	8.6	9.7	4.3	9.7	6.5	10.8	1.1	1.1	2.2	1.1	....	....	....	....	....	....	93	11.5	26	**19**
20	....	....	....	1.8	3.6	1.8	7.3	5.5	10.9	3.6	**14.5**	**14.5**	1.8	5.5	9.2	10.9	7.3	1.8	....	....	....	....	....	....	....	....	55	11.	33	**20**
Total..	.18	.12	.48	2.07	4.38	2.86	4.8	10.27	**10.39**	8.76	9.66	7.5	10.09	7.74	5.22	6.1	4.07	2.19	1.52	.55	.55	.12	.12	.18	.24	....	1,646	10.6	30	

TABLE XXXIII

City Distributions—Eighth Grade—Division: Rights. Per Cent of Children Making Each Score

CITY	Score 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total Number of Children	Median Score	Per Cent Variability	CITY
1	....	.9	....	.9	1.9	1.9	7.5	4.7	3.8	8.5	4.7	7.5	**11.4**	10.4	10.4	**11.4**	5.6	6.6	1.9	....	....	....	....	....	....	....	106	12.6	25	**1**
2	2.9	....	....	14.5	8.6	11.5	2.9	**14.5**	8.6	3.	8.6	....	8.6	2.9	....	11.5	....	....	....	....	....	....	3.	....	....	....	35	7.8	47	**2**
3	....	....	.5	2.2	3.2	8.5	8.	6.4	8.5	**14.4**	10.6	8.	8.5	7.4	5.3	3.7	1.1	1.1	1.1	.5	.5	.5	....	....	....	....	188	9.9	31	**3**
4	1.6	....	1.6	1.6	9.5	7.9	**17.4**	9.5	11.1	4.8	11.1	4.8	12.7	1.6	....	3.2	....	1.6	....	....	....	....	....	....	....	....	63	8.5	29	**4**
5	....	....	2.2	4.3	4.3	6.5	13.1	**15.3**	6.5	6.5	4.3	8.7	13.1	4.3	6.5	....	....	2.2	2.2	....	....	....	....	....	....	....	46	8.7	38	**5**
6	2.	2.	7.1	8.1	6.1	6.1	**12.1**	11.1	8.1	11.1	8.1	7.1	3.	4.	....	2.	1.	1.	....	....	....	....	....	....	....	....	99	7.9	38	**6**
7	....	....	3.4	10.4	10.4	6.9	**13.8**	....	**13.8**	10.4	6.9	10.4	3.4	3.4	3.4	3.4	....	....	....	....	....	....	....	....	....	....	29	8.5	40	**7**
8	6.9	5.2	6.9	8.6	8.6	5.2	8.6	5.2	8.6	5.2	5.2	5.2	....	**10.3**	3.4	6.9	....	....	....	....	....	....	....	....	....	....	58	7.	58	**8**
9	1.	6.1	6.1	5.	5.	**10.1**	9.1	9.1	**10.1**	2.	6.1	5.1	6.1	2.	7.1	3.	2.	1.	....	2.	....	....	1.	....	....	....	99	17.9	54	**9**
10	....	....	.8	2.5	1.6	9.	3.3	9.	6.6	9.	**11.4**	4.1	10.7	9.	6.6	5.7	2.5	2.5	1.6	.8	1.6	.8	.8	....	....	....	122	10.7	33	**10**
11	2.3	1.5	4.5	9.8	7.5	8.2	12.	6.	**10.5**	9.	8.2	3.8	3.	4.5	1.5	3.8	1.5	....	.8	....	.8	....	.8	....	....	....	133	8.1	46	**11**
12	....	1.5	1.5	4.5	7.7	6.1	**10.6**	**10.6**	4.5	7.6	9.1	9.1	7.6	4.5	4.5	7.6	3.	....	....	....	....	....	....	....	....	....	66	9.2	37	**12**
13	....	1.7	3.4	10.2	1.7	1.7	8.5	10.2	3.4	6.8	**11.8**	8.5	10.2	8.5	5.1	1.7	3.4	1.7	1.7	....	....	....	....	....	....	....	59	9.9	34	**13**
14	....	4.1	5.4	2.7	2.7	10.8	**16.2**	10.7	5.4	6.7	10.7	4.1	8.1	4.1	4.1	1.4	1.4	....	....	1.4	....	....	....	....	....	....	71	7.7	39	**14**
15	.8	2.4	6.5	7.4	3.2	5.7	8.9	11.4	8.1	**13.1**	6.5	5.7	4.9	4.9	4.9	2.4	.8	.8	....	....	1.6	....	....	....	....	....	123	8.5	41	**15**
16	....	1.5	4.5	6.	7.5	6.	10.3	**11.9**	**11.9**	3.	4.5	7.5	8.9	6.	1.5	1.5	4.5	....	1.5	....	1.5	....	....	....	....	....	67	8.3	45	**16**
17	4.7	3.1	7.8	9.4	4.7	7.8	4.7	**18.7**	7.8	4.7	1.6	1.6	7.8	4.7	4.7	3.1	....	3.1	....	....	....	....	....	....	....	....	64	7.7	56	**17**
18	1.5	....	1.5	6.2	4.6	7.7	4.6	**9.3**	**9.3**	7.7	6.2	4.6	6.2	7.7	6.2	4.6	....	3.2	....	4.6	1.5	1.5	....	....	....	....	65	10.3	40	**18**
19	1.1	4.3	6.5	4.3	3.2	4.3	8.6	9.6	8.6	**12.9**	4.3	7.5	7.5	4.3	4.3	4.3	1.1	....	2.2	1.1	....	....	....	....	....	....	93	9.8	37	**19**
20	....	1.8	3.6	5.5	1.8	3.6	7.3	9.	7.3	**12.8**	**12.8**	1.8	....	10.9	10.9	5.5	5.5	....	....	....	....	....	....	....	....	....	55	9.9	40	**20**
Total..	1.1	1.83	3.66	5.54	4.68	6.87	9.19	**9.25**	8.03	8.70	7.85	5.84	7.12	5.96	4.68	4.28	1.77	1.34	.73	.55	.48	.18	.24	....	....	....	1,644	9.12	40	

RESULTS: GRAPHS

While all the important facts are included in the foregoing tables they are much more clearly seen where shown in graphic form. In some of the graphs which follow only eighteen cities are included, since the results from two cities were not available when these graphs were made. The inclusion of these two cities would have altered both the city and individual medians in many cases. Where discrepancies between the tables and graphs are

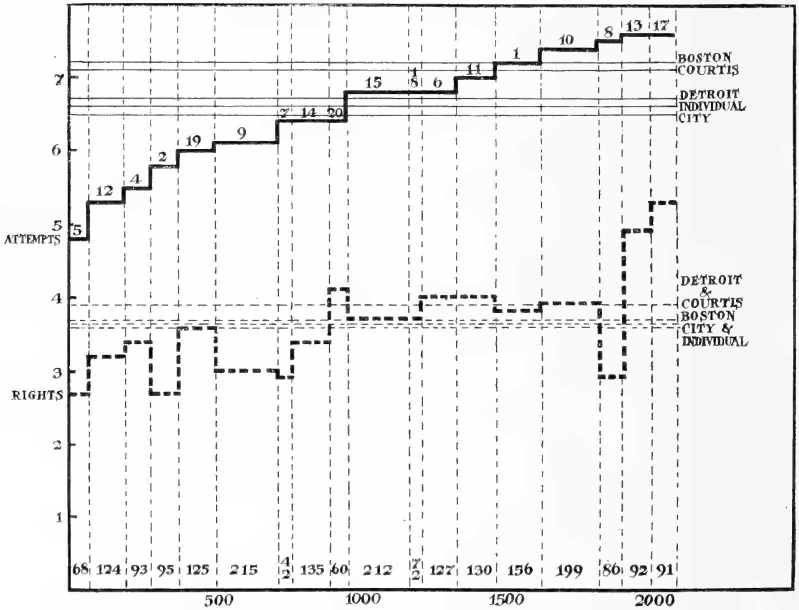

FIG. 1 MEDIANS GRADE 5 SERIES B ADDITION

found it is due to the fact that in one case the group included twenty cities and in another only eighteen.

Three sorts of graphs are shown. The first represents the medians and may be designated Form I. The second represents the variabilities and may be called Form II. The third shows dependability and is designated Form III.

In Form I the cities are arranged on the graph from left to right in an order determined by the number of problems attempted, the city at the left showing the fewest attempts. The several cities are indicated by figures placed at that part of the curve which represents the median of the city in question. The figures on

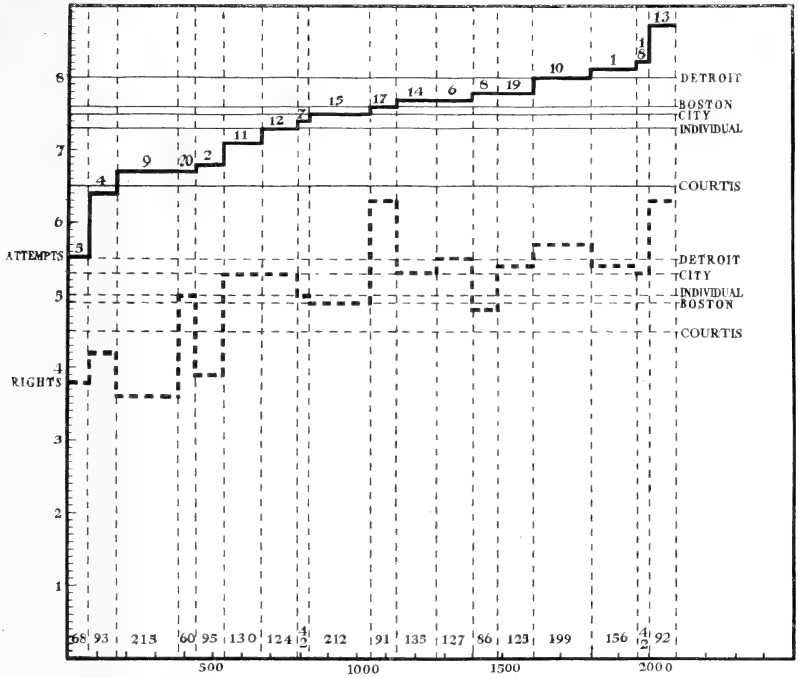

FIG. 2 MEDIANS GRADE 5 SERIES B SUBTRACTION

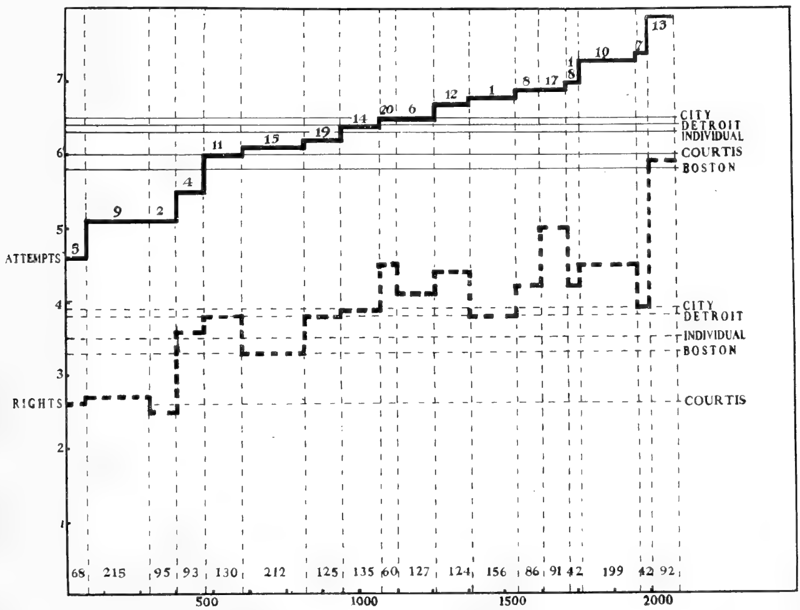

FIG. 3 MEDIANS GRADE 5 SERIES B MULTIPLICATION

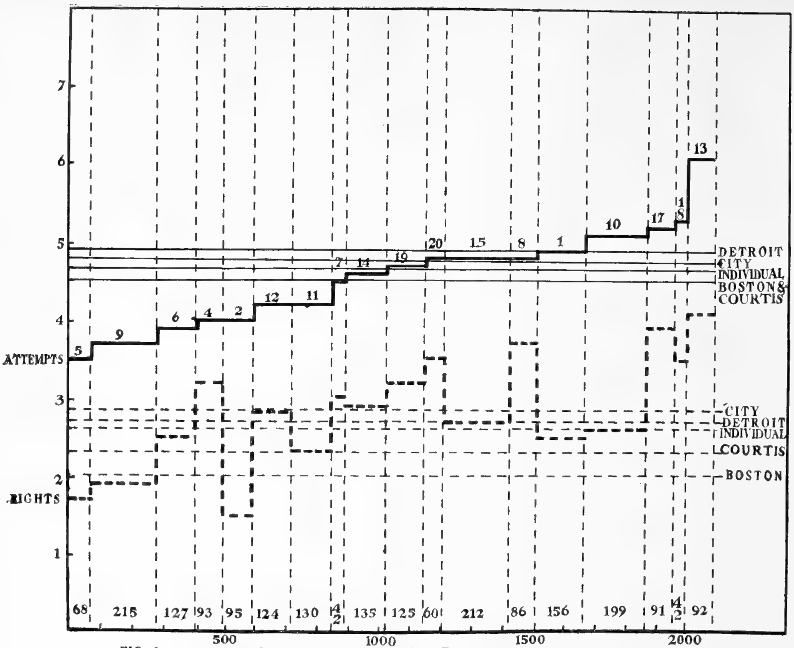

FIG. 4 MEDIANS GRADE 5 SERIES B DIVISION

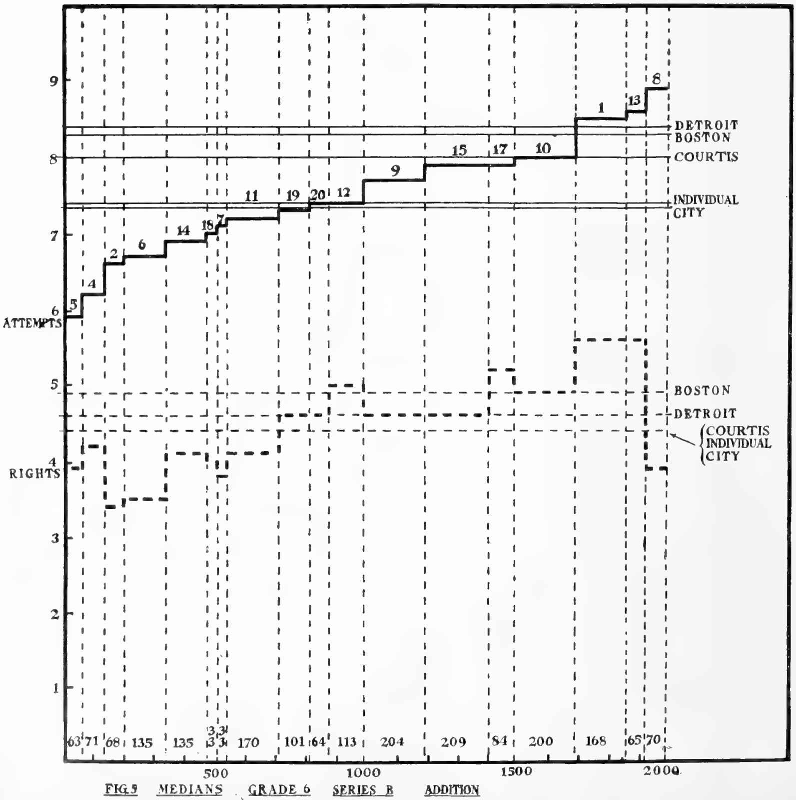

FIG. 5 MEDIANS GRADE 6 SERIES B ADDITION

the left ordinate indicate the number of problems. The figures at the bottom of the form indicate the number of children reported from each city, and the horizontal space on the chart allotted to each city is proportional to this number.

The dotted lines represent attempts, and the solid lines show

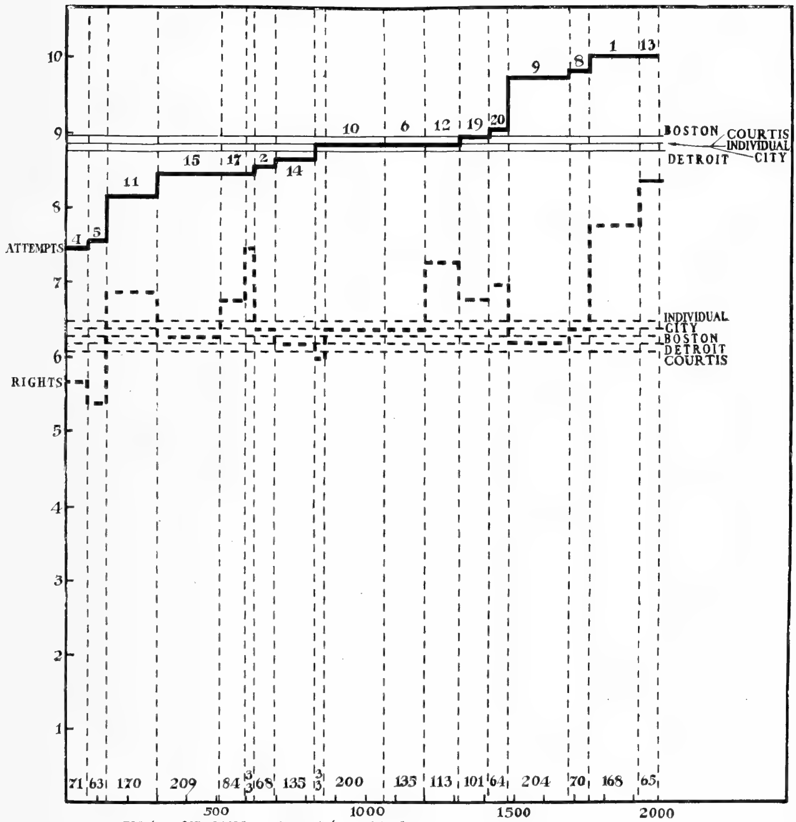

FIG. 6 MEDIANS GRADE 6 SERIES B SUBTRACTION

rights. Both the city and individual averages are represented by horizontal lines across the full width of the chart. Similarly there are shown the Courtis general standard score for February, 1914, 3,618 children; the Detroit score for February, 1914, 1,315 children; and the Boston score for February, 1914, 20,441 children. All of these are indicated on the right of the chart[1].

The reader may study the tables in either of two ways. He

[1] Courtis, S. A. *Bulletin Number Three* (Detroit, 1914).

may study a table at a time, comparing one city with another as to median, variability, mode, minimum score, maximum score, etc., or he may choose one city and follow it through each of the thirty-two tables, noting the relation of problems attempted to problems correctly solved; the relation of efficiency in addition to efficiency

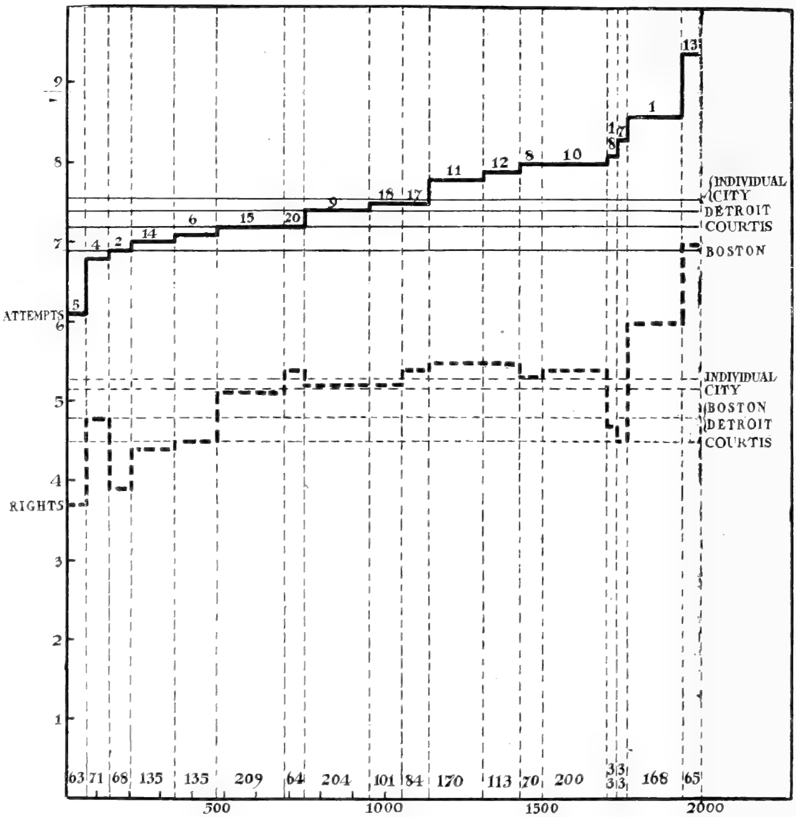

FIG. 7 MEDIANS GRADE 6 SERIES B MULTIPLICATION

in subtraction, multiplication, and division; the relative efficiency of the fifth grade to the sixth, seventh, and eighth grade.

As a sample of the first method let us take the record in Table II. Take first of all the matter of minimum score. City 19 had .7 per cent of its fifth grade (1 child) who did not attempt one problem. Cities 1, 5, 6, 10, 11 had children who attempted only one. Cities 2, 3, 4, 8, 9, 12, 14, 15, 18 and 20 had two problems as the minimum attempts, and all of the children in cities 7, 13, 16, and 17 attempted at least three problems. The variation in

case of maximum attempts is very much more striking. In city 5 no child attempted more than eight problems, while in city 1 one child attempted eighteen problems. In city 3, 11 per cent of the children attempted more problems than any of the pupils in city 5. If, instead of studying the minimum and maximum scores, it is desired to see what the bulk of the children did in the several

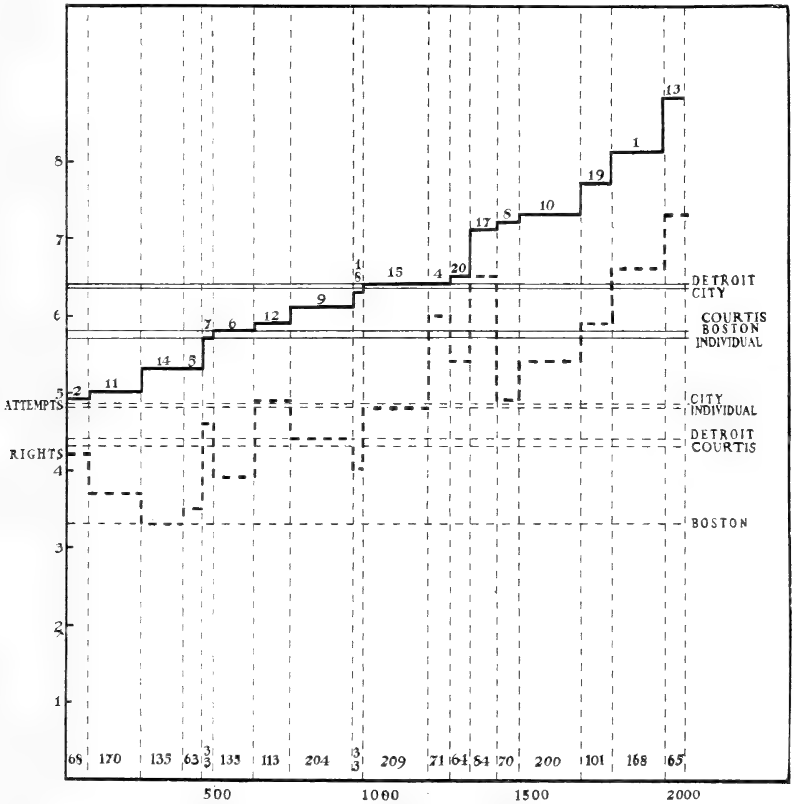

FIG. 8 MEDIANS GRADE 6 SERIES B DIVISION

cities, follow the mode which is the score made by the largest number of children. It is in bold face type. It ranges from six problems attempted, which is the mode for thirteen cities, to eight problems, the mode for city 17. In cities 13 and 20 the distribution is bimodal.

The information which one gets by studying the relative achievement of several cities as measured by any one test, say fifth grade addition, is very greatly supplemented by following a particular city through the several tables and graphs.

MEDIAN SCORES

An accurate measure of group achievement is the median score shown at the right of the tables. It ranges from 4.8 problems attempted, in the case of city 5, to 7.6 problems attempted in the

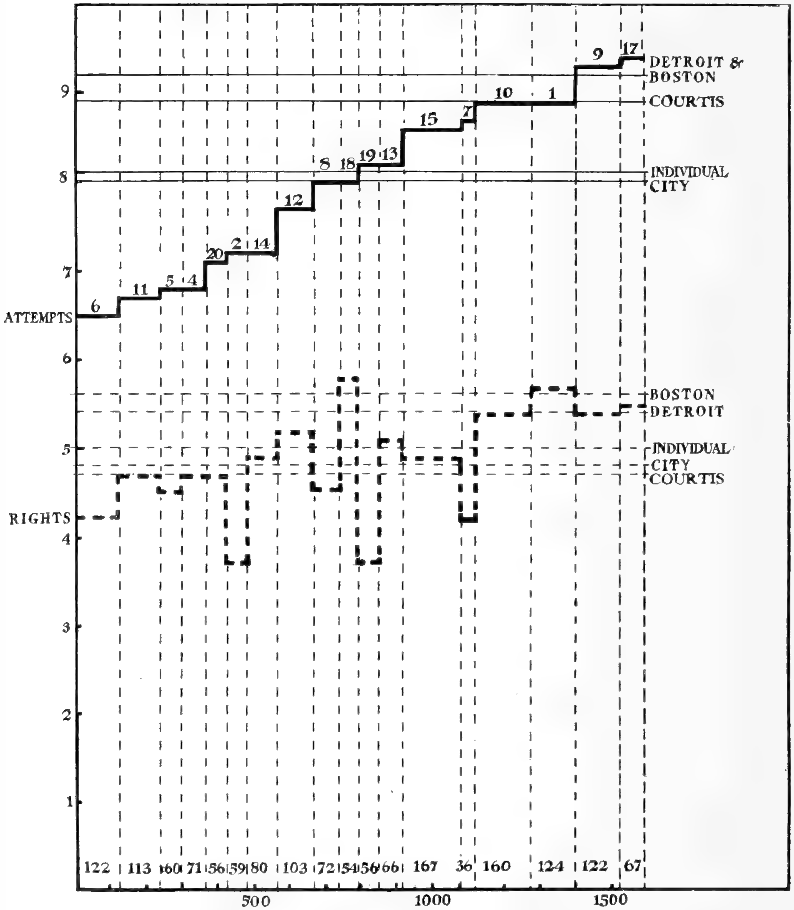

FIG. 9 MEDIANS GRADE 7 SERIES B ADDITION

case of cities 13 and 17. In figure 1 the dotted line marked "attempts" at the left represents the medians shown in Table II except that cities 3 and 16 are not included for reasons before mentioned. The solid line marked "rights" represents the medians shown in Tables III with the exceptions of cities 3 and 16.

To facilitate study, the medians for all the cities in all the

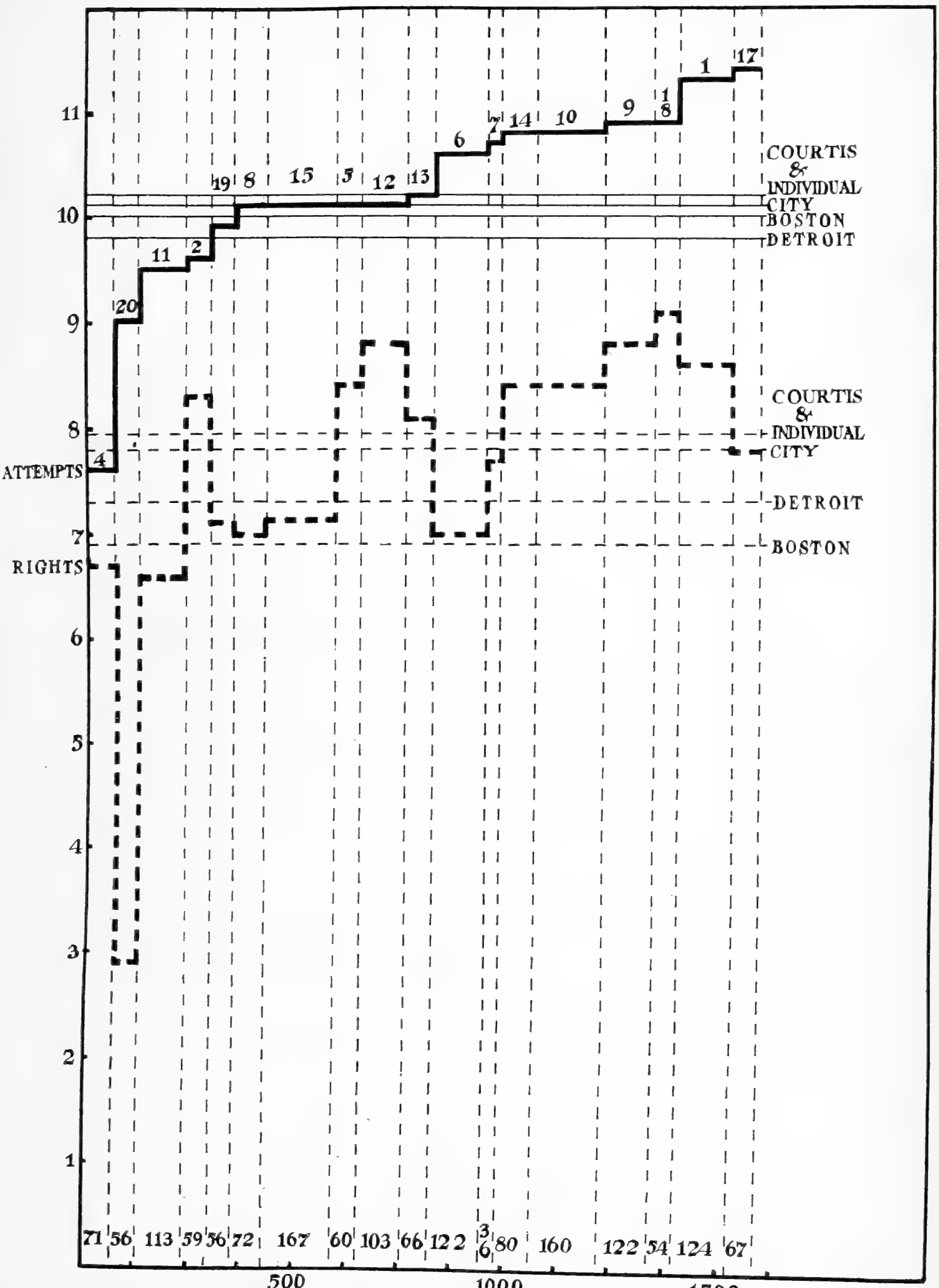

FIG. 10 MEDIANS GRADE 7 SERIES B SUBTRACTION

tests are brought together in Table XXXIV. Reading across Table XXXIV the medians for city 1 are: Fifth grade addition attempts,

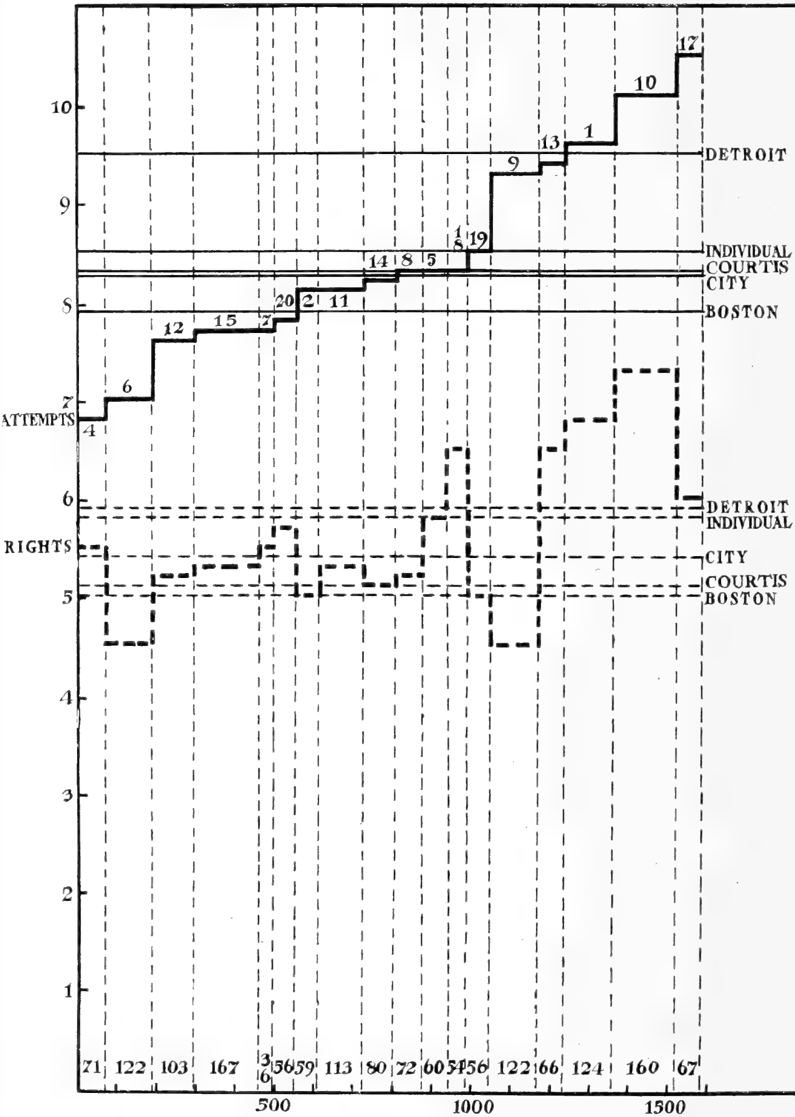

FIG. 11 MEDIANS GRADE 7 SERIES B MULTIPLICATION

7.2, rights, 3.8; subtraction attempts, 8.1, rights, 5.4, and so on through the several points. The city average at the bottom of

the table is obtained by adding the medians for the twenty cities and dividing by 20. By this method each city is considered a unit, whatever the number of pupils. The individual average is

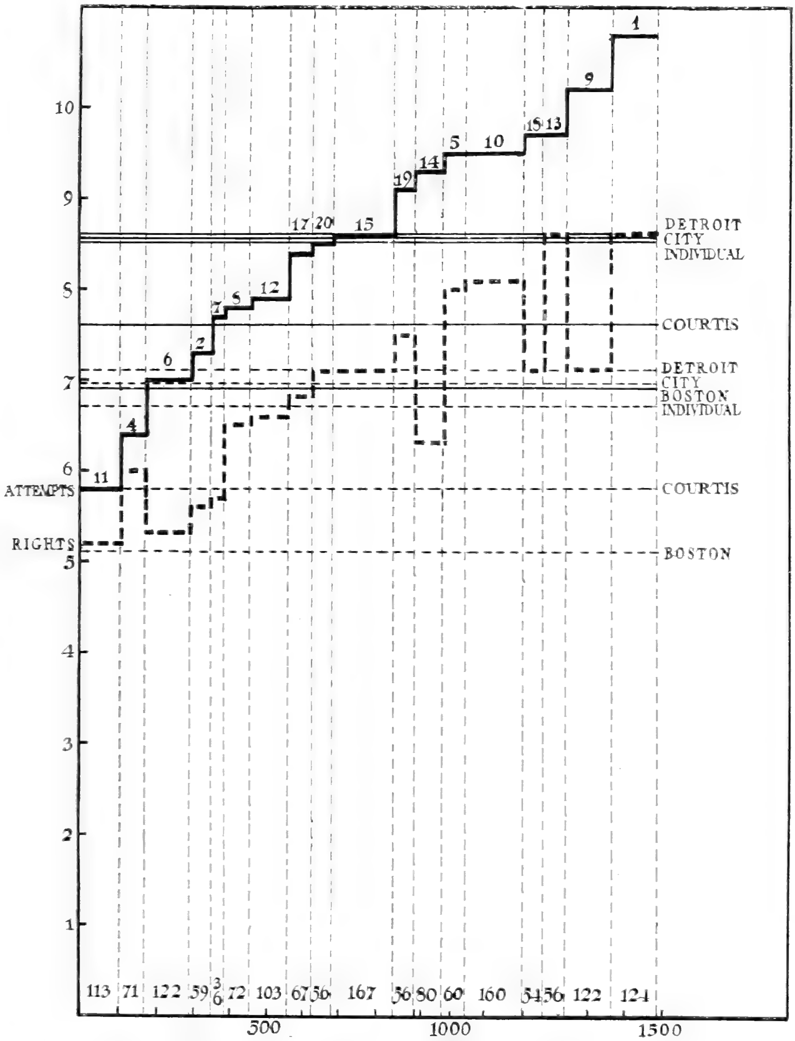

FIG. 12 MEDIANS GRADE 7 SERIES B DIVISION

obtained by adding the individuals regardless of city and finding the median of all.

Comparing the individual median with other available standards, namely, Courtis general standard and the Detroit and Boston

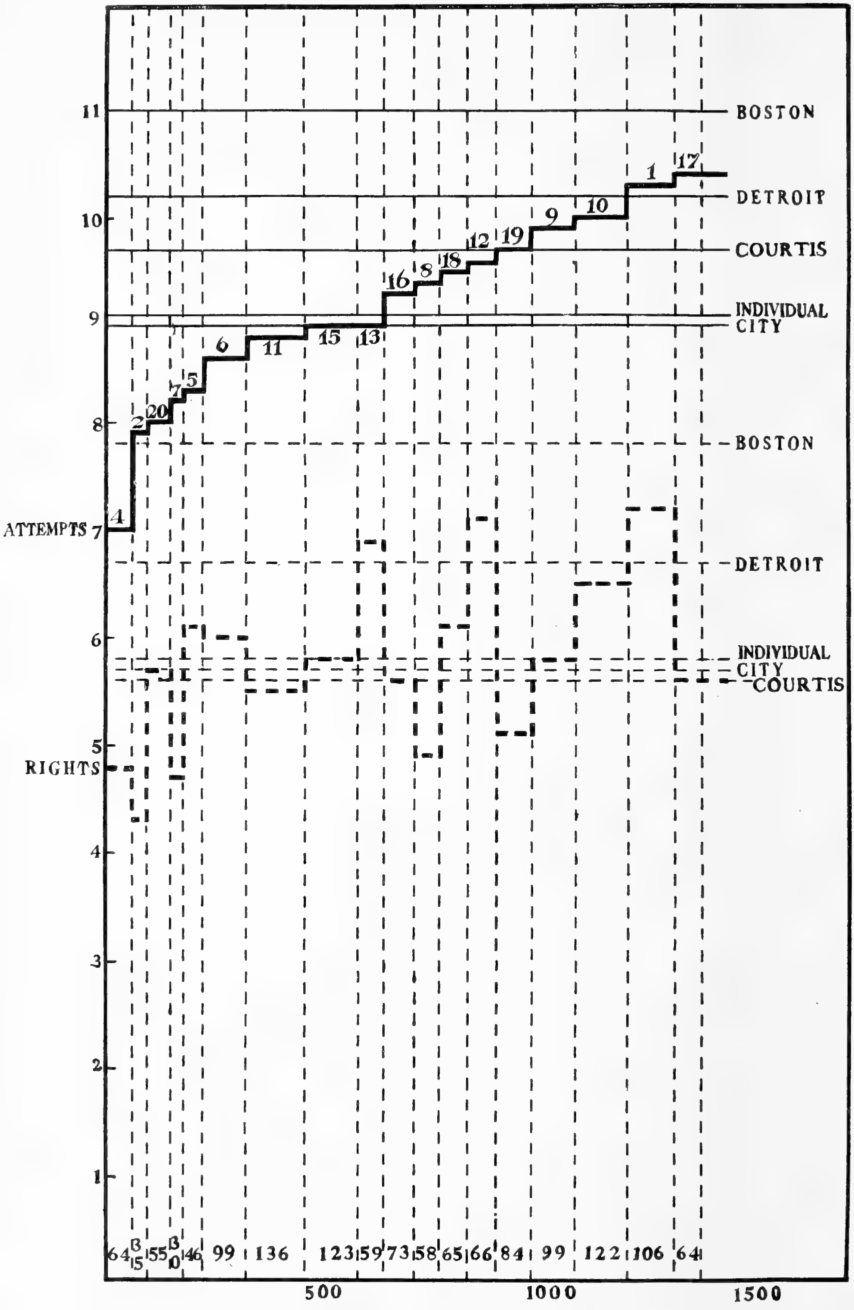

FIG. 13 MEDIANS GRADE 8 SERIES B ADDITION

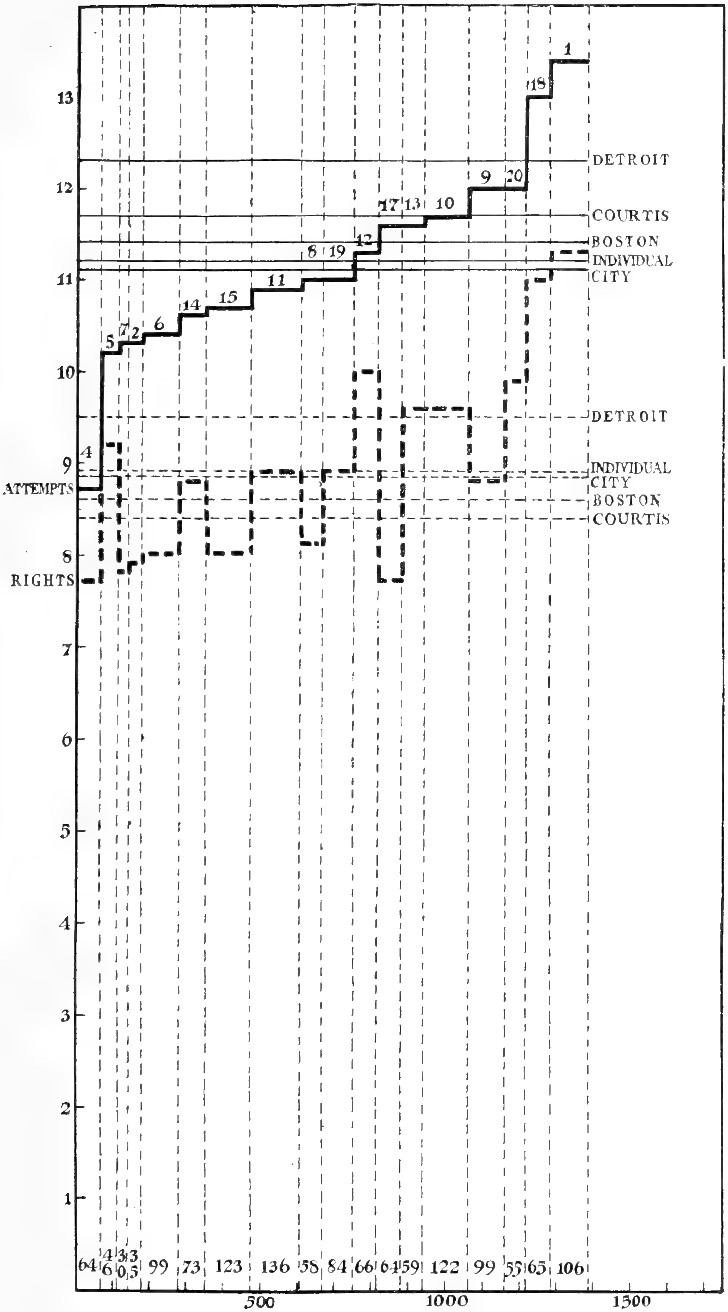

FIG. 14 MEDIANS GRADE 6 SERIES B SUBTRACTION

scores for February, 1914, the Indiana standard falls in second place in grades five, seven, and eight. In the sixth grade it is in third place, being excelled by both Boston and Detroit. In all grades the Detroit scores rank first. If one uses the Indiana city average instead of the individual average as a basis of comparison, the rank for all grades combined is the same, namely, Detroit 1, Indiana 2, Boston 3, and Courtis general 4. For the sixth grade, Indiana gets first place, but drops to third in the eighth grade. Some of the Indiana cities do much better than either Detroit, Boston, or the Courtis standard, and the comparison of the group as a whole is decidedly favorable to Indiana.

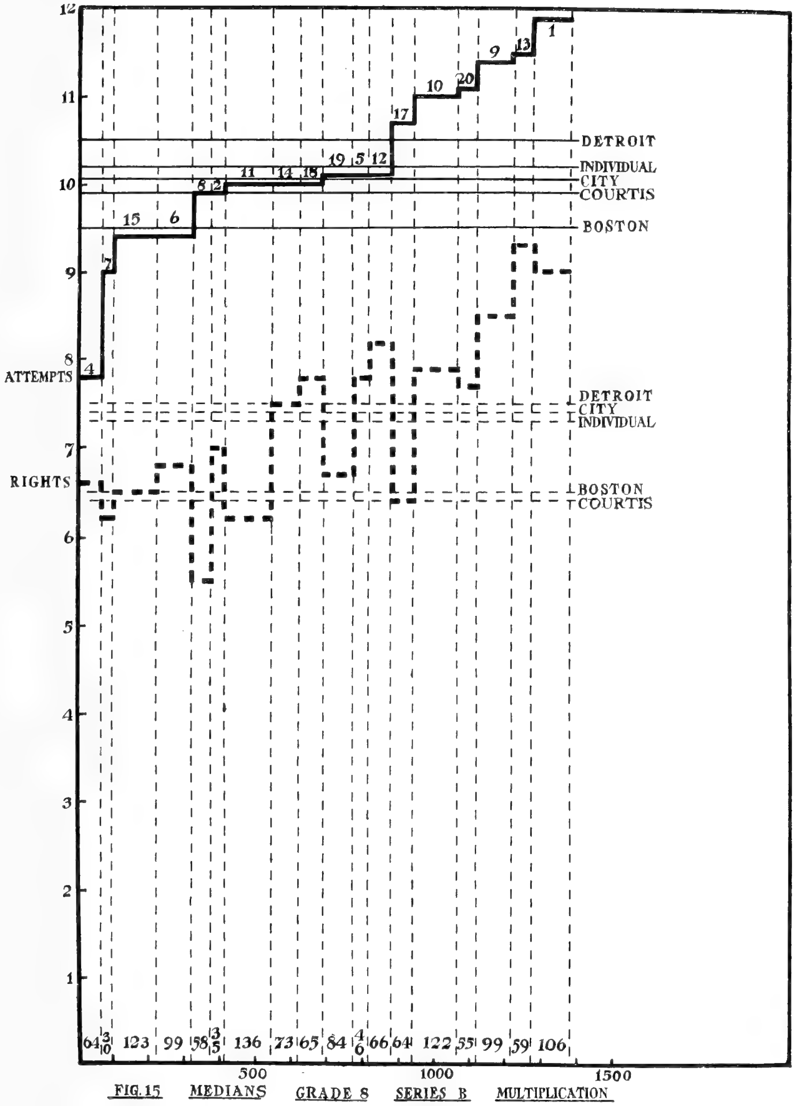

FIG. 15 MEDIANS GRADE 8 SERIES B MULTIPLICATION

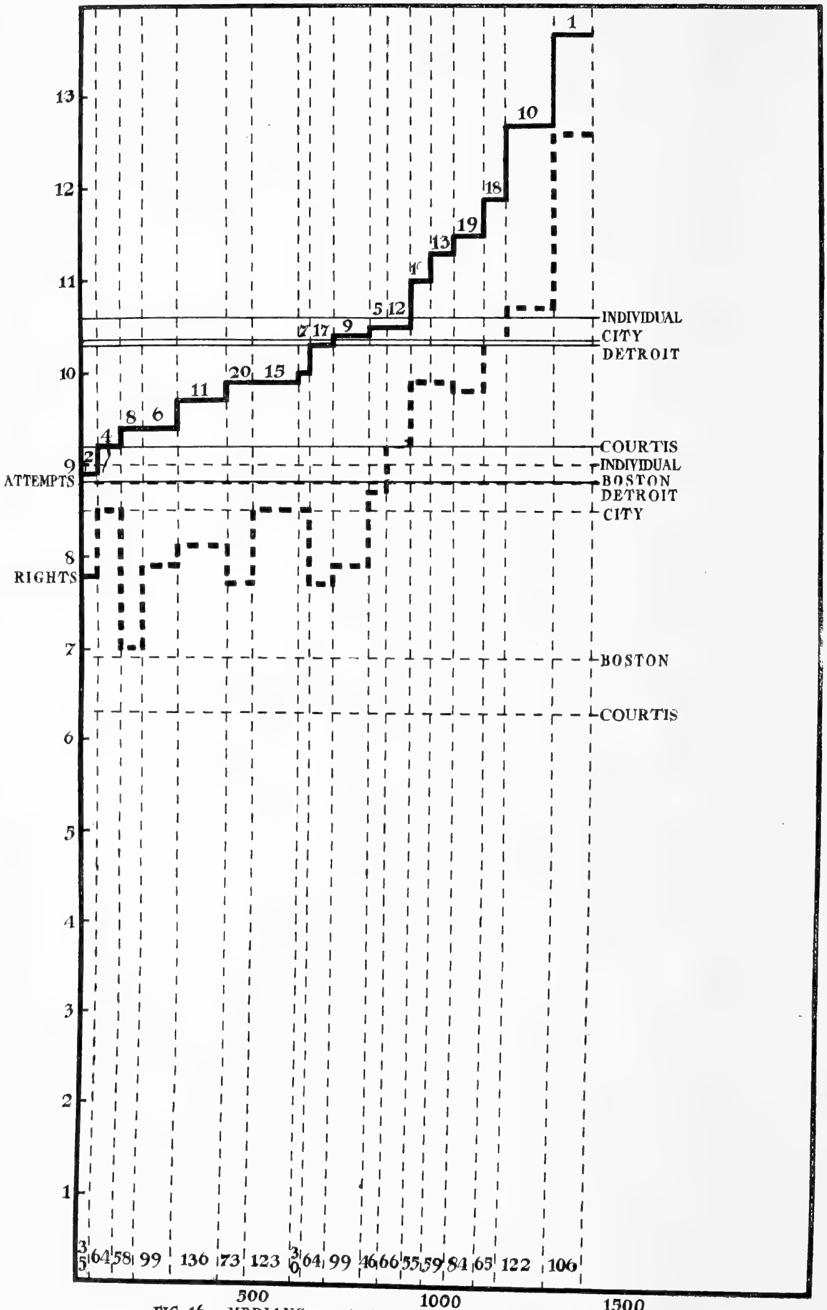

FIG. 16 MEDIANS GRADE 8 SERIES B DIVISION

TABLE XXXIV

MEDIAN SCORES—TWENTY CITIES—FOUR GRADES—FOUR TESTS. BOTH CITY AND INDIVIDUAL MEDIANS ARE SHOWN. ALSO SCORES FOR DETROIT, BOSTON AND COURTIS GENERAL SCORE, FEBRUARY 1914

CITY	Grade 5								Grade 6								CITY
	Addition		Subtraction		Multiplication		Division		Addition		Subtraction		Multiplication		Division		
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	
1	7.2	3.8	8.1	5.4	6.8	3.8	4.9	2.6	8.5	5.6	10.1	7.8	8.6	6.0	8.1	6.6	**1**
2	5.8	2.7	6.8	3.9	5.1	2.5	4.0	1.5	6.6	3.4	8.6	6.4	6.9	3.9	4.9	4.2	**2**
3	6.7	4.3	7.5	5.6	6.5	4.6	5.6	3.4	7.9	5.2	9.6	7.1	8.4	6.0	7.5	6.0	**3**
4	5.5	3.4	6.4	4.2	5.5	3.6	4.0	3.2	6.2	4.2	7.5	5.7	6.8	4.8	6.4	6.0	**4**
5	4.8	2.7	5.5	3.8	4.6	2.6	3.5	1.7	5.9	3.9	7.6	5.4	6.1	3.7	5.3	3.5	**5**
6	6.8	4.0	7.7	5.5	6.5	4.1	3.9	2.5	6.7	3.5	8.9	6.4	7.1	4.5	5.8	3.9	**6**
7	6.4	2.9	7.4	5.0	7.4	3.9	4.5	3.0	7.1	3.8	8.5	7.5	8.3	4.5	5.7	4.6	**7**
8	7.5	2.9	7.8	4.8	6.9	4.2	4.8	3.7	8.9	3.9	9.9	6.4	8.0	5.3	7.2	4.9	**8**
9	6.1	3.0	6.7	3.6	5.1	2.7	3.7	1.9	7.7	4.6	9.8	6.2	7.4	5.2	6.1	4.4	**9**
10	7.4	3.9	8.0	5.7	7.3	4.5	5.1	2.6	8.0	4.9	8.9	6.4	8.0	5.4	7.3	5.4	**10**
11	7.0	4.0	7.1	5.3	6.0	3.8	4.2	2.3	7.2	4.1	8.2	6.9	7.8	5.5	5.0	3.7	**11**
12	5.3	3.2	7.3	5.3	6.7	4.4	4.2	2.8	7.4	5.0	8.9	7.3	7.9	5.5	5.9	4.9	**12**
13	7.6	4.9	8.7	6.3	7.9	5.9	6.1	4.1	8.6	5.6	10.1	8.4	9.4	7.0	8.8	7.3	**13**
14	6.4	3.4	7.7	5.3	6.4	3.9	4.6	2.9	6.9	4.1	8.7	6.2	7.0	4.4	5.3	3.3	**14**
15	6.8	3.7	7.5	4.8	6.1	3.3	4.8	2.7	7.9	4.6	8.5	6.3	7.2	5.1	6.4	4.8	**15**
16	5.7	2.8	6.3	3.9	5.7	3.3	3.9	1.9	6.8	3.5	6.6	5.3	6.8	3.7	5.1	3.9	**16**
17	7.6	5.3	7.6	6.3	6.9	5.0	5.2	3.9	7.9	5.2	8.5	6.8	7.5	5.4	7.1	6.5	**17**
18	6.8	3.7	8.2	5.3	7.0	4.2	5.3	3.5	7.0	4.0	8.9	6.0	8.1	4.7	6.3	4.0	**18**
19	6.0	3.6	7.8	5.4	6.2	3.8	4.7	3.2	7.3	4.6	9.0	6.8	7.5	5.2	7.7	5.9	**19**
20	6.4	4.1	6.7	5.0	6.5	4.5	4.8	3.0	7.4	4.6	9.1	7.0	7.2	5.4	6.5	5.4	**20**
Individual	6.6	3.6	7.3	5.0	6.3	3.9	4.5	2.6	7.4	4.4	8.9	6.5	7.6	5.1	5.7	4.8	Individual
City	6.5	3.6	7.5	5.3	6.5	3.9	4.6	2.8	7.3	4.4	8.9	6.4	7.5	5.2	6.3	4.8	City
Detroit	6.7	3.9	8.0	5.5	6.4	3.8	4.9	2.7	8.4	4.6	8.8	6.2	7.4	4.8	6.4	4.4	Detroit
Boston	7.2	3.7	7.6	4.9	5.8	3.3	4.5	2.0	8.3	4.9	9.0	6.3	6.9	4.8	5.8	3.3	Boston
Courtis Standard	7.1	3.9	6.5	4.5	6.0	2.6	4.5	2.3	8.0	4.4	8.9	6.1	7.2	4.5	5.8	4.3	Courtis Standard

TABLE XXXIV—Continued

MEDIAN SCORES—TWENTY CITIES—FOUR GRADES—FOUR TESTS. BOTH CITY AND INDIVIDUAL MEDIANS ARE SHOWN. ALSO SCORES FOR DETROIT, BOSTON AND COURTIS GENERAL SCORE, FEBRUARY 1914

CITY	GRADE 7								GRADE 8								CITY
	Addition		Subtraction		Multiplication		Division		Addition		Subtraction		Multiplication		Division		
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	
1	8.9	5.7	11.3	8.6	9.7	6.9	10.8	8.5	10.2	7.2	13.4	11.3	11.9	9.0	13.7	12.6	**1**
2	7.2	3.7	9.6	8.3	8.2	5.1	7.3	5.6	7.9	4.3	10.3	7.9	9.9	7.0	8.9	7.8	**2**
3	9.0	6.4	10.	8.4	9.2	6.9	9.3	8.1	8.7	6.2	11.2	9.3	10.	7.7	11.2	9.9	**3**
4	6.8	4.7	7.6	6.7	6.9	5.6	6.4	6.0	7.0	4.8	8.7	7.7	7.8	6.6	9.2	8.5	**4**
5	6.8	4.5	10.1	8.4	8.4	5.9	9.2	8.0	8.3	6.1	10.2	9.2	10.1	7.8	10.5	8.7	**5**
6	6.5	4.2	10.6	7.0	7.1	4.6	7.4	5.3	8.6	6.0	10.4	8.0	9.4	6.8	9.4	7.9	**6**
7	8.7	4.2	10.7	7.7	7.8	5.6	7.7	5.7	8.2	4.7	10.3	7.8	9.0	6.2	10.0	8.5	**7**
8	8.0	4.5	10.1	7.0	8.4	5.3	7.8	6.5	9.3	4.9	11.0	8.1	9.9	5.5	9.4	7.0	**8**
9	9.3	5.4	10.9	8.8	9.4	4.6	10.2	7.1	9.8	5.8	12.0	8.8	11.4	8.5	10.4	7.9	**9**
10	8.3	5.4	10.8	8.4	10.2	7.4	9.5	8.1	9.9	6.5	11.7	9.6	11.0	7.9	12.7	10.7	**10**
11	6.7	4.7	9.5	6.6	8.2	5.4	5.8	5.2	8.8	5.5	10.9	8.9	10.0	6.2	9.7	8.1	**11**
12	7.7	5.2	10.1	8.8	7.7	5.3	7.8	6.6	9.5	7.1	11.3	10.0	10.1	8.2	10.5	9.2	**12**
13	8.2	5.1	10.2	8.1	9.5	6.6	9.7	8.6	8.9	6.9	11.6	9.6	11.5	9.3	11.3	9.9	**13**
14	7.2	4.9	10.8	8.4	8.3	5.2	9.3	6.5	9.2	5.6	10.6	8.8	10.0	7.5	9.9	7.7	**14**
15	8.6	4.9	10.1	7.1	7.8	5.4	8.6	7.1	8.9	5.8	10.7	8.0	9.4	6.5	9.9	8.5	**15**
16	8.0	4.2	9.6	6.7	7.8	4.4	7.5	4.8	8.6	4.1	11.5	8.6	10.6	7.3	9.8	8.3	**16**
17	9.4	5.5	11.4	7.8	10.6	6.1	8.4	6.8	10.3	5.6	11.6	7.7	10.7	6.4	10.3	7.7	**17**
18	8.0	5.8	10.9	9.1	8.4	6.6	9.7	7.1	9.4	6.1	13.0	11.0	10.0	7.8	11.9	10.3	**18**
19	8.2	3.7	9.9	7.1	8.6	5.1	9.1	7.5	9.6	5.1	11.0	8.9	10.7	6.7	11.5	9.8	**19**
20	7.1	4.7	9.0	7.8	7.9	5.8	8.5	7.1	8.0	5.7	12.0	9.9	11.1	7.7	11.0	9.9	**20**
Individual	8.0	5.0	10.1	7.8	8.6	5.9	8.5	6.7	9.0	5.8	11.2	8.9	10.2	7.3	10.6	9.0	Individual
City	8.0	4.8	10.1	7.9	8.3	5.5	8.5	6.9	8.7	5.7	11.1	8.9	8.8	7.4	10.3	8.5	City
Detroit	9.2	5.4	9.8	7.3	9.6	6.0	8.6	7.1	10.2	6.7	12.3	9.5	10.5	7.5	10.3	8.8	Detroit
Boston	9.2	5.6	10.0	6.9	8.0	5.1	6.9	5.1	11.0	7.8	11.4	8.6	9.5	6.5	8.8	6.9	Boston
Courtis Standard	8.9	4.7	10.2	7.8	8.4	5.2	7.6	5.8	9.7	5.6	11.7	8.4	9.9	6.4	9.2	6.3	Courtis Standard

In Table XXXV these medians are ranked. Rank 1 is given to the city having the highest median, rank 2 means second highest median, and so on. Reading down column 2, fifth grade addition attempts, we find city 1 has rank 5, city 2 rank 16, and so on to city 20 with rank 12. Inasmuch as the several cities do not maintain the same rank in all points, a composite rank is made by adding across the table the ranks made in the thirty-two points. On this basis a new ranking is made which may be regarded as showing the relative standing of each city in the entire set of tests so far as such relative standing is shown by median scores. The figures indicating this composite ranking are found in the first column to the left of the table.

It is interesting to note that cities do not maintain the same rank in all the measures. Thus city 10, which has first place in seventh grade multiplication rights and which ranks 3 in the entire set of tests, falls to rank 13 in fifth grade division rights. City 13, ranking first in the entire set and having first in eleven of the separate tests, falls to rank 10 in seventh grade subtraction rights and 10.5 in eighth grade addition attempts. In the latter point it is no better than city 15 whose composite rank is 12. City 1 is interesting as ranking first in all eighth grade points except two, and ranking second in these, but falling to fourteenth place in fifth grade division rights and not rising above third place in any fifth grade measure. If the relative achievement of a school system is a valid measure of its work then it ought not be difficult for any one of the school cities here concerned to locate its strengths and weaknesses. The sore spots are indicated by the high numbers and wherever the number is greater than ten that city is below the average. Numbers less than ten mean better than the average. These ranks indicate therefore where attention should be given. City 1 and city 9 should look to their fifth grades, city 15 is better everywhere than in its eighth grade, and city 13 is poorer in addition in three grades than in any of the other processes. In the seventh it is weakest in subtraction.

There is consolation in this table, however, for every city. There is not a case where a city does not do better than the average in at least one thing. City 2, with composite rank 20, ranks 9 in seventh grade subtraction rights, and in several other points it approximates the average. In only five cases is it really the lowest; in every other case some one of the other cities is lower than city 2.

Just because a city does vary so from measure to measure, the composite rank is probably not a good measure to rely upon. From the standpoint of administration it is worth very much more to know the city's rank in a particular test. To find a city in rank 11 indicates to that city that its work should be improved. Just how it should be improved is not so clear. But to see that in the fifth grade addition attempts it ranks 3 while in rights it ranks 16.5 is to locate exactly the spot where attention should be given.

TABLE XXXV

RANKING OF TWENTY CITIES IN MEDIAN SCORES

CITY.	Rank in All Points	Grade 5 Addition Attempts	Grade 5 Addition Rights	Grade 5 Subtraction Attempts	Grade 5 Subtraction Rights	Grade 5 Multiplication Attempts	Grade 5 Multiplication Rights	Grade 5 Division Attempts	Grade 5 Division Rights	Grade 6 Addition Attempts	Grade 6 Addition Rights	Grade 6 Subtraction Attempts	Grade 6 Subtraction Rights	Grade 6 Multiplication Attempts	Grade 6 Multiplication Rights	Grade 6 Division Attempts	Grade 6 Division Rights	CITY
1	2	5	8	3	6.5	7	13	6	14.5	3	1.5	1.5	2	2	2.5	2	2	1
2	20	16	19.5	15	17.5	18.5	20	15.5	20	18	20	13	1.5	7	8	20	14	2
3	4	10	3	10.5	4	10	3	2	6	6	3.5	5	5	3	2.5	4	4.5	3
4	18	18	12.5	18	16	17	15	15.5	7.5	19	11	19	18	18.5	13	9.5	4.5	4
5	17	20	19.5	20	19	20	19	20	19	20	15.5	18	19	20	19.5	16.5	19	5
6	16	8	5.5	7.5	5	10	9	17.5	14.5	17	18.5	9.5	11.5	15	19.5	14	16.5	6
7	14	12	16.5	12	12.5	2	10.5	12	9	13	17	15	3	4	15.5	15	12	7
8	11	3	16.5	5.5	14.5	5.5	7.5	8	3	1	15.5	3	11.5	6.5	9	6	9.5	8
9	10	14	15	16.5	20	18.5	18	19	17.5	8	8.5	4	15.5	12	10.5	12	13	9
10	3	4	7	4	3	3	4.5	5	13	4	6	9.5	11.5	6.5	7	5	7.5	10
11	15	6	5.5	14	9.5	15	13	13.5	16	12	12.5	17	7	9	4.5	19	18	11
12	7	19	14	13	9.5	8	6	13.5	11	9.5	5	9.5	4	8	4.5	13	9.5	12
13	1	1.5	2	1	1.5	1	1	1	1	2	1.2	1.5	1	1	1	1	1	13
14	13	12	12.5	7.5	9.5	12	10.5	11	10	15	12.5	12	15.5	16	17	16.5	20	14
15	12	8	9.5	10.5	14.5	14	16.5	8	12	6	8.5	15	14	13.5	12	9.5	11	15
16	19	17	18	19	17.5	16	16.5	17.5	17.5	16	18.5	20	20	18.5	19	18	16.5	16
17	5	1.5	1	9	1.5	5.5	2	4	2	6	3.5	15	8.5	10.5	7	7	3	17
18	6	8	9.5	2	9.5	4	7.5	3	4.5	14	14	9.5	17	5	14	11	15	18
19	9	15	11	5.5	6.5	13	13	10	7.5	11	8.5	7	8.5	10	10.5	3	6	19
20	8	12	4	16.5	12.5	10	4.5	8	4.5	9.5	8.5	6	6	13.5	7	8	7.5	20

TABLE XXXV—Continued

RANKING OF TWENTY CITIES IN MEDIAN SCORES

CITY	Rank in All Points	Grade 7 Addition Attempts	Grade 7 Addition Rights	Grade 7 Subtraction Attempts	Grade 7 Subtraction Rights	Grade 7 Multiplication Attempts	Grade 7 Multiplication Rights	Grade 7 Division Attempts	Grade 7 Division Rights	Grade 8 Addition Attempts	Grade 8 Addition Rights	Grade 8 Subtraction Attempts	Grade 8 Subtraction Rights	Grade 8 Multiplication Attempts	Grade 8 Multiplication Rights	Grade 8 Division Attempts	Grade 8 Division Rights	CITY
1	2	4.5	3	2	4	3	2.5	1	1.5	2	1	1	1	1	2	1	1	**1**
2	20	14.5	19.5	16.5	9	12.5	16.5	18	17	19	19	17.5	17	15.5	12	20	17	**2**
3	4	3	1	14	6.5	6	2.5	6.5	3.5	13	5	10	7	12.5	8.5	6	5	**3**
4	18	17.5	12	20	18.5	20	9.5	19	15	20	17	20	19.5	20	15	19	11	**4**
5	17	17.5	14.5	11.5	6.5	9	7	8	5	16	6.5	19	8	9	6.5	8.5	9	**5**
6	16	20	17	8	16.5	19	18.5	17	18	14.5	8	16	15	17.5	13	17.5	15.5	**6**
7	14	6	17	7	13	16	9.5	15	16	17	18	17	18	19	18	12	11	**7**
8	11	11	14	11.5	16.5	9	13.5	13.5	13.5	8	6	11.5	14	15.5	20	17.5	20	**8**
9	10	2	5.5	3.5	2.5	5	18.5	2	8.5	4	9.5	3.5	11.5	3	3	10	15.5	**9**
10	3	4.5	5.5	5.5	6.5	2	1	5	3.5	3	4	5	5.5	5	5	2	2	**10**
11	15	19	12	18	20	12.5	11.5	20	19	12	14	13	9.5	12.5	18.5	16	14	**11**
12	7	13	7	11.5	2.5	18	13.5	13.5	12	6	2	9	3	9	4	8.5	8	**12**
13	1	8.5	8	9	10	4	4.5	3.5	1.5	10.5	3	6.5	5.5	2	1	5	5	**13**
14	13	14.5	9.5	5.5	6.5	11	15	6.5	13.5	9	12.5	15	11.5	12.5	10	13.5	18.5	**14**
15	12	7	9.5	11.5	14.5	16	11.5	10	8.5	10.5	9.5	14	15.5	17.5	16	13.5	11	**15**
16	19	11	17	16.5	18.5	16	20	16	20	14.5	20	8	3	7	11	15	13	**16**
17	5	1	4	1	11.5	1	6	12	11	1	12.5	6.5	19.5	6	17	11	18.5	**17**
18	6	11	2	3.5	1	9	4.5	3.5	8.5	7	6.5	2	2	12.5	6.5	3	3	**18**
19	9	8.5	19.5	15	14.5	7	16.5	9	6	5	15	11.5	9.5	9	14	4	7	**19**
20	8	16	12	19	11.5	14	8	11	8.5	18	11	3.5	4	4	8.5	7	5	**20**

SPECIFIC CHARACTER OF HABITS

The variability of rankings shown by this table emphasizes a fundamental fact in educational psychology, a fact very generally neglected by educational theorists. This fact is the very specific character of the habits formed in the learning of any one of the skills measured in these tests. A study of this table will show that efficiency in one process does not necessarily mean efficiency in any other process. Children may add well and subtract poorly as in the case of city 20, fifth grade, or may multiply well and add poorly as in city 5, seventh grade, or may divide well and subtract poorly as in city 19, eighth grade. What does this mean except that children learn those skills in which they are effectively trained? The others they do not learn.

One does not learn subtraction by learning addition, nor does he learn division by drill on multiplication. To be sure there must be some overlapping from one process to another. There is some addition in multiplication and in long division both multiplication and subtraction function. But apart from these evident overlappings there are habits quite specifically characteristic of each process which are learned only by drill in that process alone. The almost anarchic tendency shown in these tables for children to be strong in one thing and weak in another is doubtless to be accounted for by the specific nature of the habits demanded in each case. To learn addition is not to learn subtraction, and to learn subtraction is not to learn multiplication, and so on. To extend the argument one could say that to learn any one or all of the processes is certainly not to learn the whole of arithmetic or the whole of mathematics, nor is the learning of mathematics, however thorough, anything more than the acquisition of skills and habits thoroughly specific and limited. It is not "the training of the mind" in any other sense. The virtue of such specific training is, of course, to be determined by the degree to which such specific habits function practically in the life of the individual.

VARIABILITY

Just as the median is a better measure of group achievement than the mode, so the per cent of variability is a better measure of the distribution of ability than are the minimum and maximum scores. In the tables the per cent of variability is given to the right of the median. In Table II it ranges from 24 in cities 7, 10, 13, and 15 to 30 in city 4, and 33 in city 5. The desideratum

for any class is of course a high median with a low per cent of variability. Measured by this combined standard city 13 stands first with a median of 7.6 and a variability of 24. City 10 is

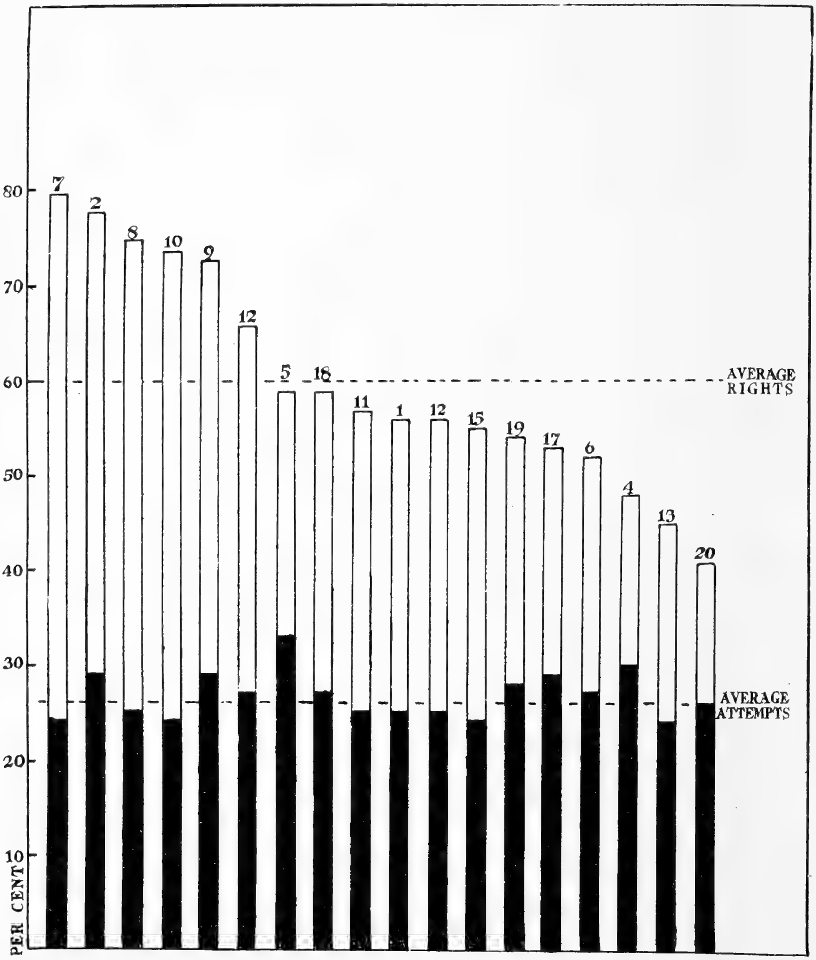

FIG. 17—VARIABILITY SERIES B GRADE 5 ADDITION

almost as good, but falls .2 in median score. City 8 is essentially as good as city 10, having .1 better median but 1 per cent poorer variability. At the opposite end of the scale is city 5 with the lowest median in the group and with the widest range of ability in the same class.

The variabilities for the several grades of the several cities are

brought together in Table XXXVI and are shown graphically in the Form II charts, Figs. 17-30.

The Form II charts show the variabilities of the several grades in each of eighteen cities. Each column represents a city, the

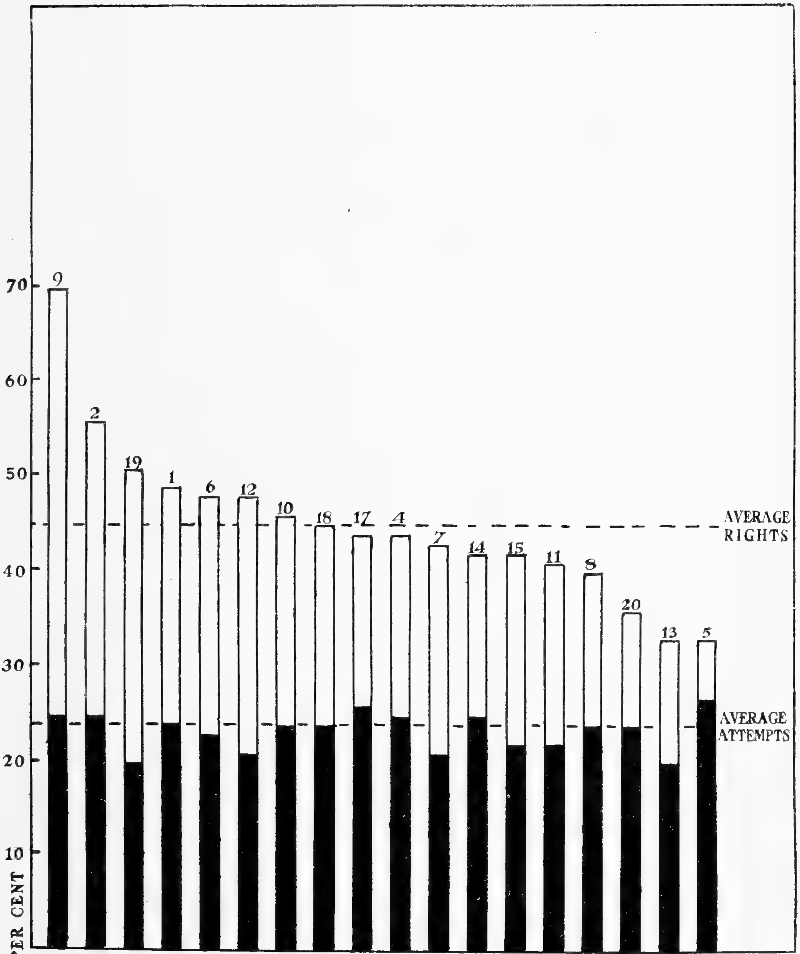

FIG. 18-VARIABILITY SERIES B GRADE 5 SUBTRACTION

height of the column being proportional to the per cent of variability shown. The solid part of the column represents variability in attempts; the open part of the column shows the variability in rights. The average for the eighteen cities is shown by horizontal lines across the chart. The figures on the left show per cents

In Table XXXVII the several cities are ranked as to the vari-

abilities of the several grades. As in the case of the medians there is great fluctuation from grade to grade and from process to process within the several grades. At the left of the table there is given a composite rank. As in the case of medians, city 13 ranks

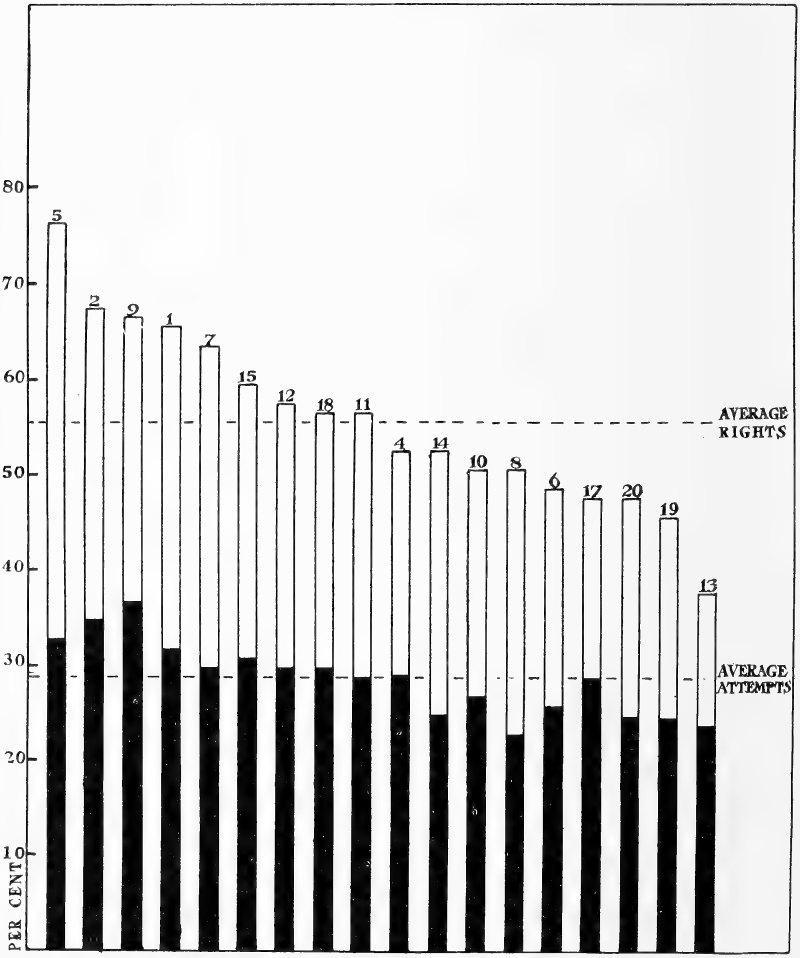

FIG. 19-VARIABILITY SERIES B GRADE 5 MULTIPLICATION

first and city 2 ranks last. Taking the entire group there is between the rankings in the two tables a positive correlation of .794 figured by "method of rank differences." Just why this correlation should occur is not altogether clear.

The per cent of variability of a class is a measure of the closeness of grading. Closeness of grading is essentially grouping to-

gether pupils of the same ability. An apparent closeness of grading may be secured by spending much time on the weak pupils and little on the strong so that all will do about the same work.

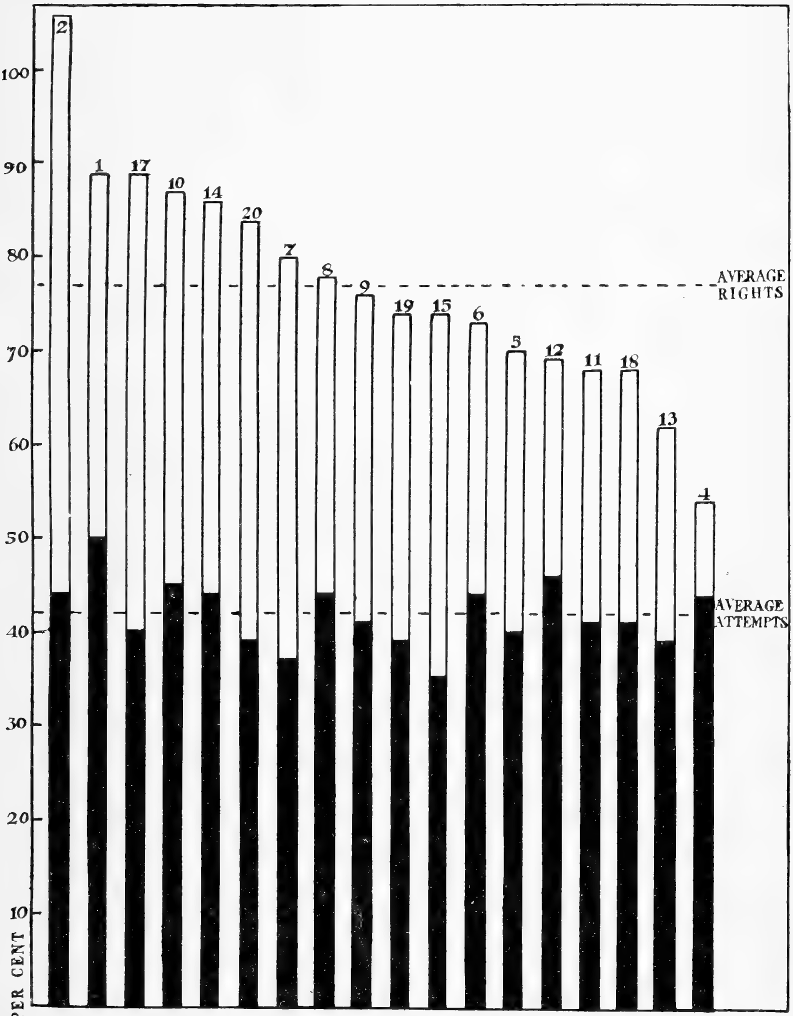

FIG. 20 - VARIABILITY SERIES B GRADE 5 DIVISION

The latter method seems to be regarded by some as efficient teaching. It may be doubted whether it really is. In any case if the class is homogeneous, the students being all very much alike in achievement, the per cent of variability will be low. Inversely, a

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high per cent of variability means that the class is loosely graded, the same class containing children of very unequal achievement. Just how small the per cent of variability should be for good school work is as yet an undetermined fact. Mr. Courtis declares

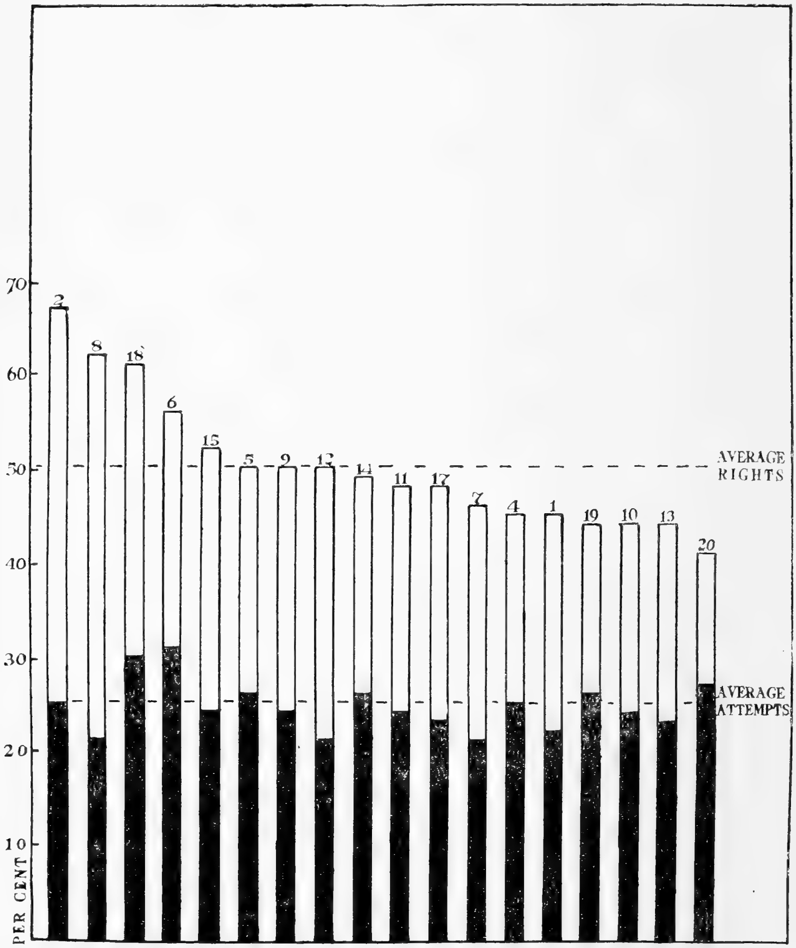

FIG. 21 - VARIABILITY SERIES B GRADE 6 ADDITION

that *"the smaller the variability, other things being equal, the more efficient the teaching. Variabilities of 12 per cent to 15 per cent represent good work under present conditions. In the near future these will probably be reduced to 5 per cent and 10 per cent."*

Measured by this standard no one of the cities is doing "good work." A variability of 16 per cent is the low mark (city 17, grade 7, subtraction, attempts), and but fourteen times out of a possible six hundred forty is the variability below 20 per cent.

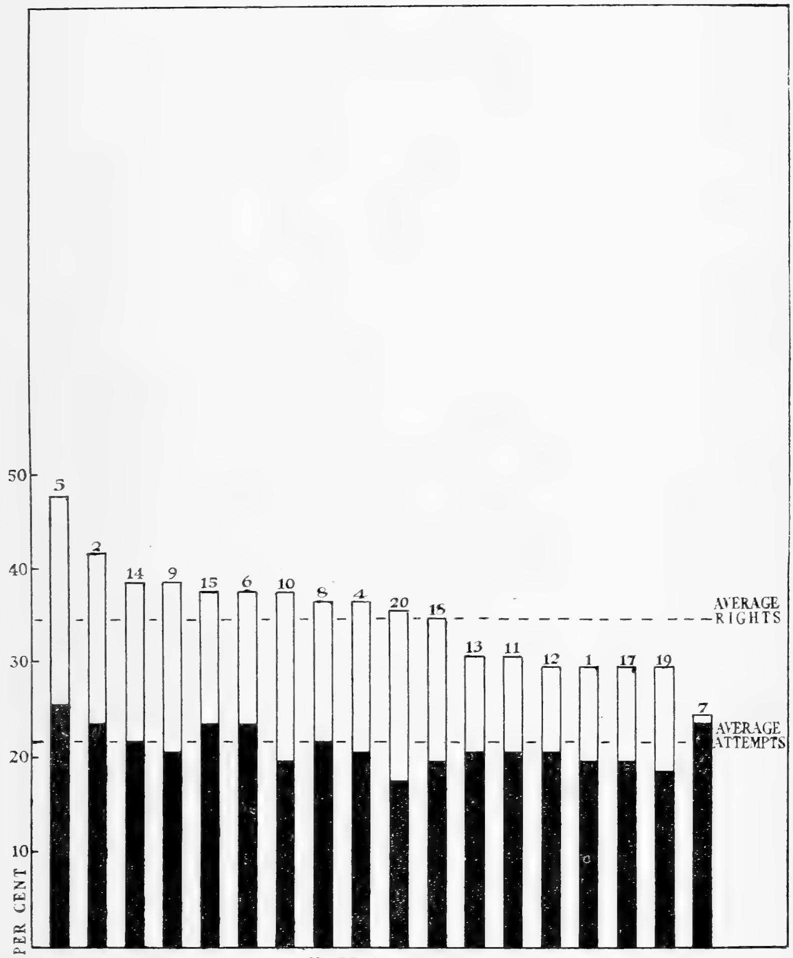

FIG. 22—VARIABILITY SERIES B GRADE 6 SUBTRACTION

It ranges in the other direction to 107 per cent and a mark of 50 per cent is not uncommon. In three cases in thirty-two, the city average is above fifty.

Whether or not a high variability within a class is bad depends somewhat upon the methods of teaching. Methods are conceivable

whereby persons of very different abilities may be handled successfully in the same group. Mr. Courtis in his practice pads has devised one such method. In case such methods are used and no limit is put upon the training the results of the tests might

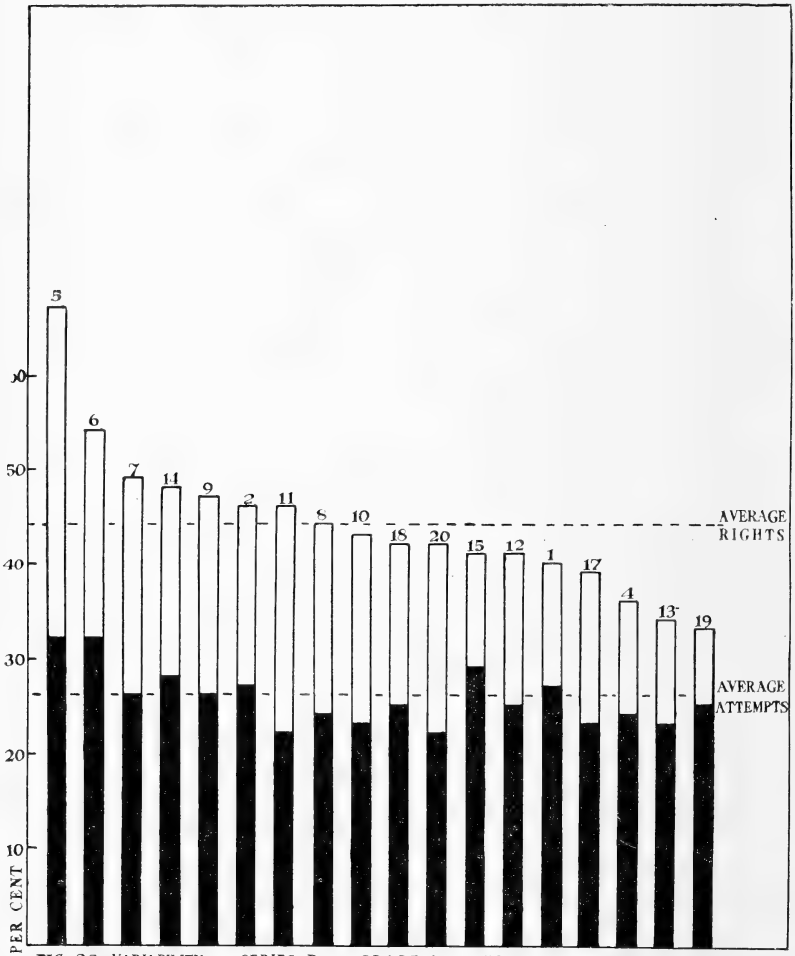

FIG. 23 VARIABILITY SERIES B GRADE 6 MULTIPLICATION

show high variability. Even here, however, it might not be desirable because in the interests of all-round efficiency the training in a particular skill should be limited. With this in mind it seems that a low variability indicates wise selection of pupils, or good teaching, or both.

Granting this and fixing the maximum variability much higher than Mr. Courtis's figure, say from 20 per cent to 25 per cent, it seems that present work in the Indiana schools leaves much to be desired. It is a fair guess that the exceedingly high figures shown

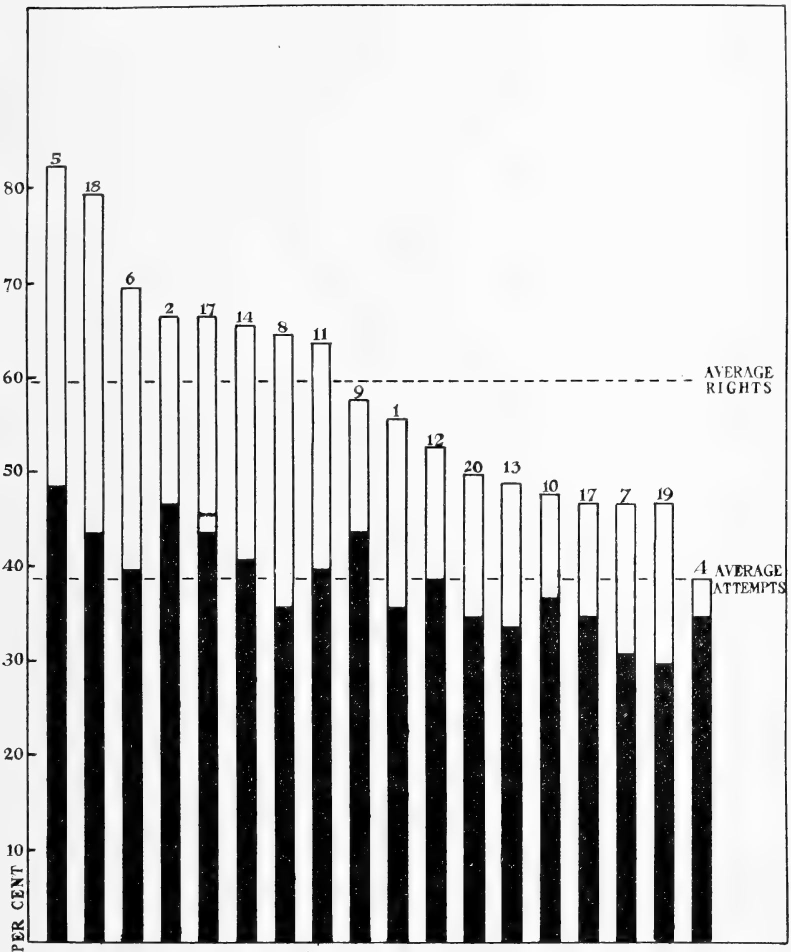

FIG. 24—VARIABILITY SERIES B GRADE 6 DIVISION

in Table XXXVII are due to our constant failure to know the needs of individual children. They indicate the failure of our group methods of instruction. He who would reduce these figures for his school must learn how to administer to individual children. He must know what the attainment for a particular grade should

be. He must learn how to bring every child up to that standard and how to occupy the time of the child who has reached that

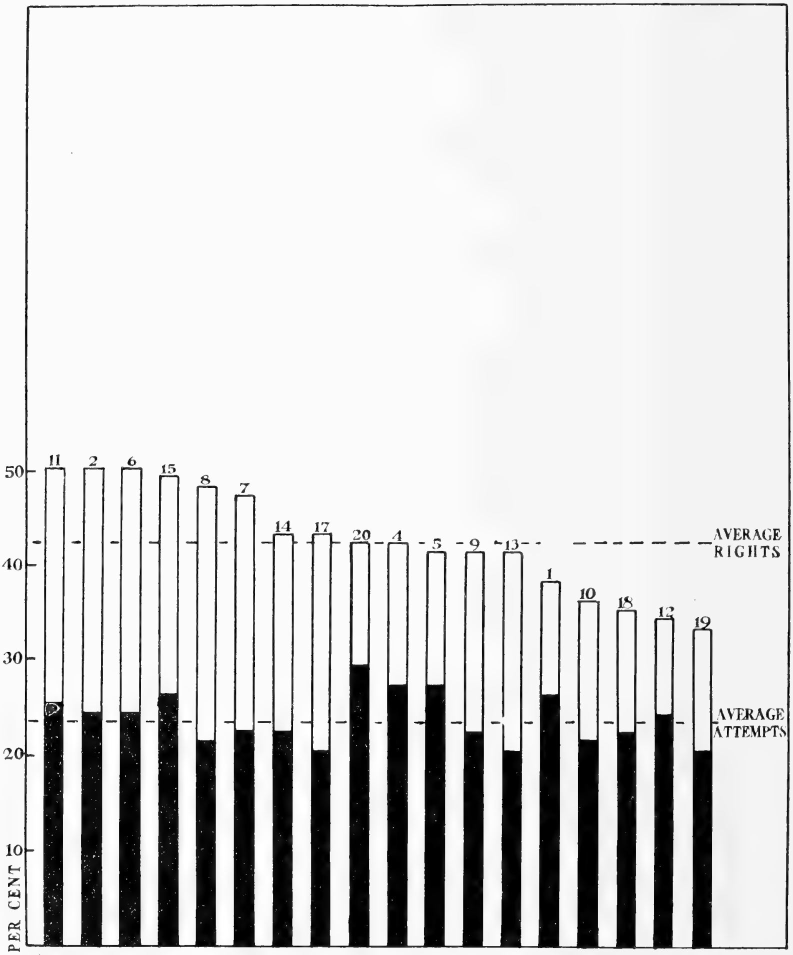

FIG. 25 - VARIABILITY SERIES B GRADE 7 ADDITION

standard with other useful things. The detailed machinery for successfully doing this thing is not yet made. The task of making it should elicit inventive genius of a high order.

TABLE XXXVI

VARIABILITIES. TWENTY CITIES—FOUR GRADES—FOUR TESTS. ALSO CITY AND INDIVIDUAL VARIABILITIES

CITY	Grade 5								Grade 6								CITY
	Addition		Subtraction		Multiplication		Division		Addition		Subtraction		Multiplication		Division		
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	
1	25	56	24	49	32	66	51	90	23	46	20	30	28	41	36	56	**1**
2	29	78	25	56	35	68	45	107	26	68	24	42	28	47	47	67	**2**
3	27	51	23	36	23	39	39	68	25	46	22	34	26	38	35	48	**3**
4	30	48	25	44	29	53	45	55	26	46	21	37	25	37	35	39	**4**
5	33	59	33	27	37	77	46	88	27	51	26	48	33	68	49	83	**5**
6	27	52	23	48	26	49	45	79	32	57	24	38	33	55	40	70	**6**
7	24	80	21	43	30	64	42	77	22	47	24	25	27	50	31	59	**7**
8	25	75	21	48	23	51	36	75	22	63	22	37	25	45	36	65	**8**
9	29	73	25	70	37	67	47	70	25	51	21	39	27	48	44	58	**9**
10	24	74	24	40	27	51	40	85	25	45	20	38	24	44	37	48	**10**
11	25	57	22	41	29	57	42	69	25	49	21	31	23	47	40	64	**11**
12	27	66	24	46	30	58	45	74	22	51	21	30	26	42	39	53	**12**
13	24	45	20	33	24	38	40	63	24	45	21	31	24	35	34	44	**13**
14	25	56	25	42	25	53	45	87	27	50	22	39	29	49	41	66	**14**
15	24	55	22	42	31	60	38	81	25	53	24	38	30	42	44	67	**15**
16	26	82	25	49	30	67	44	84	26	66	33	47	28	51	45	67	**16**
17	29	53	26	44	29	48	41	90	24	49	20	30	24	40	35	47	**17**
18	27	59	24	45	30	57	42	69	31	62	20	35	26	43	44	80	**18**
19	28	54	20	51	22	46	41	71	27	45	19	30	26	34	30	47	**19**
20	26	41	24	36	25	48	40	75	28	42	18	36	23	43	35	50	**20**
Individual	29	58	25	46	30	56	42	81	26	52	22	37	28	47	46	60	Individual
City	26.5	56.5	24	44	29	55	42	76	25	44.5	21	36.5	26	43.5	38	57	City

TABLE XXXVI—Continued

VARIABILITIES. TWENTY CITIES—FOUR GRADES—FOUR TESTS. ALSO CITY AND INDIVIDUAL VARIABILITIES

CITY	Grade 7								Grade 8								CITY
	Addition		Subtraction		Multiplication		Division		Addition		Subtraction		Multiplication		Division		
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	
1.........	27	39	21	31	25	36	25	35	22	41	22	27	19	28	21	25	**1**
2.........	25	51	22	33	29	53	44	50	23	47	23	34	23	39	27	47	**2**
3.........	22	37	19	26	23	29	27	35	23	39	21	24	20	25	27	31	**3**
4.........	28	43	27	29	26	33	40	41	32	34	21	28	27	26	24	29	**4**
5.........	28	42	23	30	30	34	34	49	30	41	21	24	24	33	32	38	**5**
6.........	25	51	23	32	27	49	22	31	26	39	19	29	23	34	29	38	**6**
7.........	23	48	20	33	24	47	45	47	23	51	21	27	27	40	27	40	**7**
8.........	22	49	18	32	23	43	31	43	26	54	24	40	29	53	40	58	**8**
9.........	23	42	19	26	20	37	29	37	21	39	23	32	22	33	54	54	**9**
10.........	22	37	19	31	22	28	31	37	21	39	21	29	22	28	23	55	**10**
11.........	26	51	23	33	27	41	38	53	20	47	22	30	25	36	32	46	**11**
12.........	25	35	23	26	26	39	29	40	23	32	20	22	22	30	32	37	**12**
13.........	21	42	20	29	27	34	29	39	23	42	17	25	19	29	23	34	**13**
14.........	23	44	23	36	27	46	34	45	23	50	21	35	23	38	31	39	**14**
15.........	27	50	22	38	29	37	37	52	25	43	24	30	30	41	33	41	**15**
16.........	29	60	24	34	34	59	45	48	26	63	20	36	19	37	27	45	**16**
17.........	21	44	16	31	24	47	33	60	24	48	21	43	25	41	33	56	**17**
18.........	23	36	19	29	20	40	27	48	21	38	21	27	26	32	26	40	**18**
19.........	21	34	19	29	24	44	37	36	21	47	19	28	21	36	26	37	**19**
20.........	30	43	31	32	24	40	30	40	21	34	22	25	21	30	33	40	**20**
Individual.	26	46	22	32	27	41	35	46	24	41	22	31	25	34	30	40	Individual
City.......	23	43	21.5	31	25.5	40	32	42	23	41.5	21	28.5	23	33.5	28	39.5	City

TABLE XXXVII

RANK OF TWENTY CITIES IN VARIABILITIES

CITY	Rank in All Points	Grade 5 Addition Attempts	Grade 5 Addition Rights	Grade 5 Subtraction Attempts	Grade 5 Subtraction Rights	Grade 5 Multiplication Attempts	Grade 5 Multiplication Rights	Grade 5 Division Attempts	Grade 5 Division Rights	Grade 6 Addition Attempts	Grade 6 Addition Rights	Grade 6 Subtraction Attempts	Grade 6 Subtraction Rights	Grade 6 Multiplication Attempts	Grade 6 Multiplication Rights	Grade 6 Division Attempts	Grade 6 Division Rights	CITY
1	6	6.5	9.5	11	16.5	17	16	20	18.5	4	6	4.5	3.5	15	6	8.5	9	**1**
2	20	17	18	16	19	18	19	15	20	13	20	16.5	18	15	13.5	19	16	**2**
3	2	12	4	7.5	3.5	2.5	2	3	3	9	6	13	8	9.5	4	5.5	5.5	**3**
4	8	19	3	16	10.5	10	9.5	15	1	13	6	9	11.5	6.5	3	5.5	1	**4**
5	18	20	12.5	20	1.0	19	20	18	17	16	13	19	20	19.5	20	20	20	**5**
6	15	12.5	5	7.5	14.5	7	6	15	12	20	16	16.5	14	19.5	19	12.5	18	**6**
7	11	2.5	19	3.5	9.0	13.5	15	10	11	2	8	16.5	1	12.5	17	2	11	**7**
8	14	6.5	17	3.5	14.5	25	7.5	1	9.5	2	18	13	11.5	6.5	12	8.5	13	**8**
9	13	17	15	16	20	19.5	17.5	19	6	9	13	9	16.5	12.5	15	16	10	**9**
10	4	2.5	16	11	5	8	7.5	5	15	9	3	4.5	14	4	11	10	5.5	**10**
11	12	6.5	10	5.5	6	10	11.5	10	4.5	9	9.5	9	6.5	1.5	13.5	12.5	12	**11**
12	7	12.5	14	11	13	13.5	13	15	8	2	13	9	3.5	9.5	7.5	11	8	**12**
13	1	2.5	2	15	2	4	1	5	2	5.5	3	9	6.5	4	2	3	2	**13**
14	16	6.5	9.5	16	7.5	5.5	9.5	15	16	16	11	13	16.5	17	16	14	14	**14**
15	17	2.5	8.0	5.5	7.5	16	14	2	13	9	15	16.5	14	18	7.5	16	16	**15**
16	19	9.5	20	16	16.5	13.5	17.5	12	14	13	19	20	19	15	18	18	16	**16**
17	10	17	6	19	10.5	10	4.5	7.5	18.5	5.5	9.5	4.5	3.5	4	5	5.5	3.5	**17**
18	9	12.5	12.5	11	12	13.5	11.5	10	4.5	19	17	4.5	9	9.5	9.5	16	19	**18**
19	3	15	7	1.5	18	1.0	3	7.5	7.0	16	3	2	3.5	9.5	1	1	3.5	**19**
20	5	9.5	1	11	3.5	5.5	4.5	5	9.5	18	1	1	10	1.5	9.5	5.5	7	**20**

TABLE XXXVII—Continued

RANK OF TWENTY CITIES IN VARIABILITIES

CITY	Rank in All Points	Grade 7 Addition Attempts	Grade 7 Addition Rights	Grade 7 Subtraction Attempts	Grade 7 Subtraction Rights	Grade 7 Multiplication Attempts	Grade 7 Multiplication Rights	Grade 7 Division Attempts	Grade 7 Division Rights	Grade 8 Addition Attempts	Grade 8 Addition Rights	Grade 8 Subtraction Attempts	Grade 8 Subtraction Rights	Grade 8 Multiplication Attempts	Grade 8 Multiplication Rights	Grade 8 Division Attempts	Grade 8 Division Rights	CITY
1.......	6	15.5	6	10	10	10	6	2	2.5	7	9.5	15	7	2	3.5	1	1	**1**
2.......	20	12	18	11.5	16	17	19	18	17	10.5	14	17.5	16	11	16	8.5	17	**2**
3.......	2	5	4.5	5	2	4.5	2	3.5	2.5	10.5	6.5	9.5	2.5	4	1	8.5	3	**3**
4.......	8	17.5	10.5	19	5.5	11.5	3	17	10	20	2.5	9.5	9.5	17.5	2	3	2	**4**
5.......	18	17.5	8	15	8	19	4.5	12.5	16	19	9.5	9.5	2.5	13	9.5	14	8.5	**5**
6.......	15	12	18	15	13	14.5	18	1	1	17	6.5	2.5	2.5	11	11	11	8.5	**6**
7.......	11	8.5	14	8.5	16	7.5	8	19.5	15	10.5	18	9.5	7	17.5	17	8.5	12	**7**
8.......	14	5	15	2	13	4.5	14	9.5	11	17	19	19.5	19	19	20	20	20	**8**
9.......	13	8.5	8	5	2	1.5	8	6	5.5	4	6.5	17.5	15	8	9.5	19	18	**9**
10.......	4	5	4.5	5	10	3	1	9.5	5.5	4	6.5	9.5	11.5	8	3.5	4	4	**10**
11.......	12	14	18	15	16	14.5	13	16	19	1	14	15	13.5	14.5	12.5	14	16	**11**
12.......	7	12	2	15	2	11.5	10	6	8.5	10.5	1	4.5	1	8	6.5	14	6.5	**12**
13.......	1	2	8	8.5	5.5	14.5	4.5	6	7	10.5	11	1	4.5	2	5	2	5	**13**
14.......	16	8.5	12.5	15	19	14.5	16	12.5	12	10.5	17	9.5	17	11	15	12	10	**14**
15.......	17	15.5	16	11.5	20	17.5	8	14.5	18	15	12	19.5	13.5	20	18.5	17	14	**15**
16.......	19	19	20	18	18	20	20	19.5	14.5	17	20	4.5	18	2	14	8.5	15	**16**
17.......	10	2	12.5	1	10	7.5	17	11	20	14	16	9.5	20	14.5	18.5	17	19	**17**
18.......	9	8.5	3	5	5.5	1.5	11.5	3.5	14.5	4	4	9.5	7	16	8	5.5	12	**18**
19.......	3	2	1	5	5.5	7.5	15	14.5	4	4	14	2.5	9.5	5.5	12.5	5.5	6.5	**19**
20.......	5	20	10.5	20	13	7.5	11.5	8	8.5	4	2.5	15	4.5	5.5	6.5	17	12	**20**

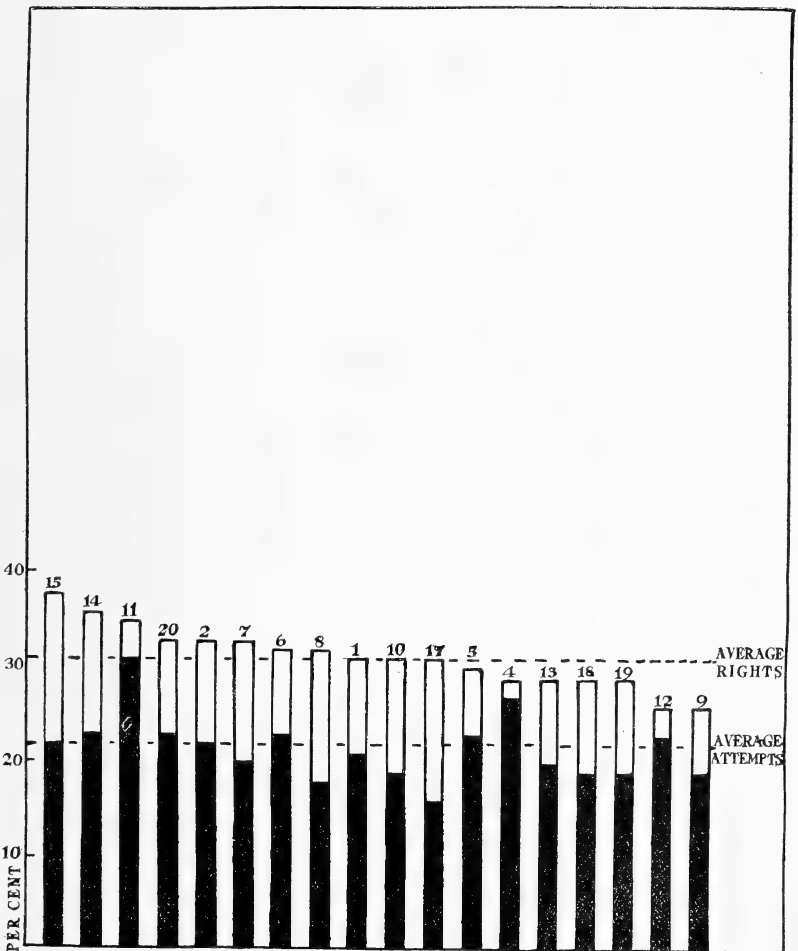

FIG. 26 VARIABILITY SERIES B GRADE 7 SUBTRACTION

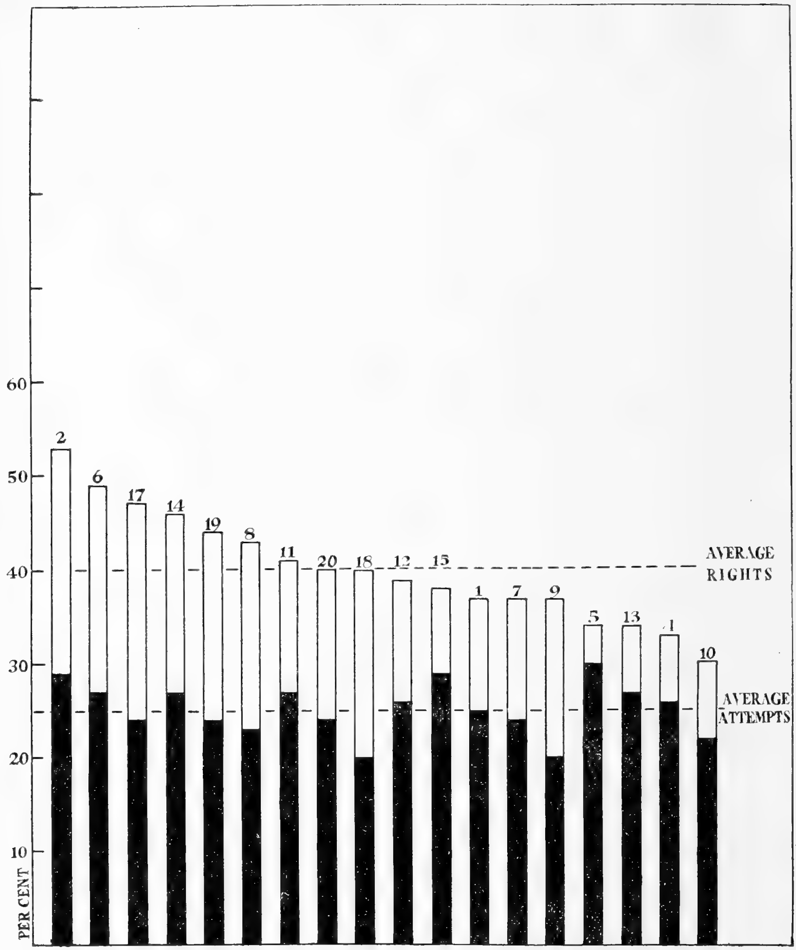

FIG. 27 VARIABILITY SERIES B GRADE 7 MULTIPLICATION

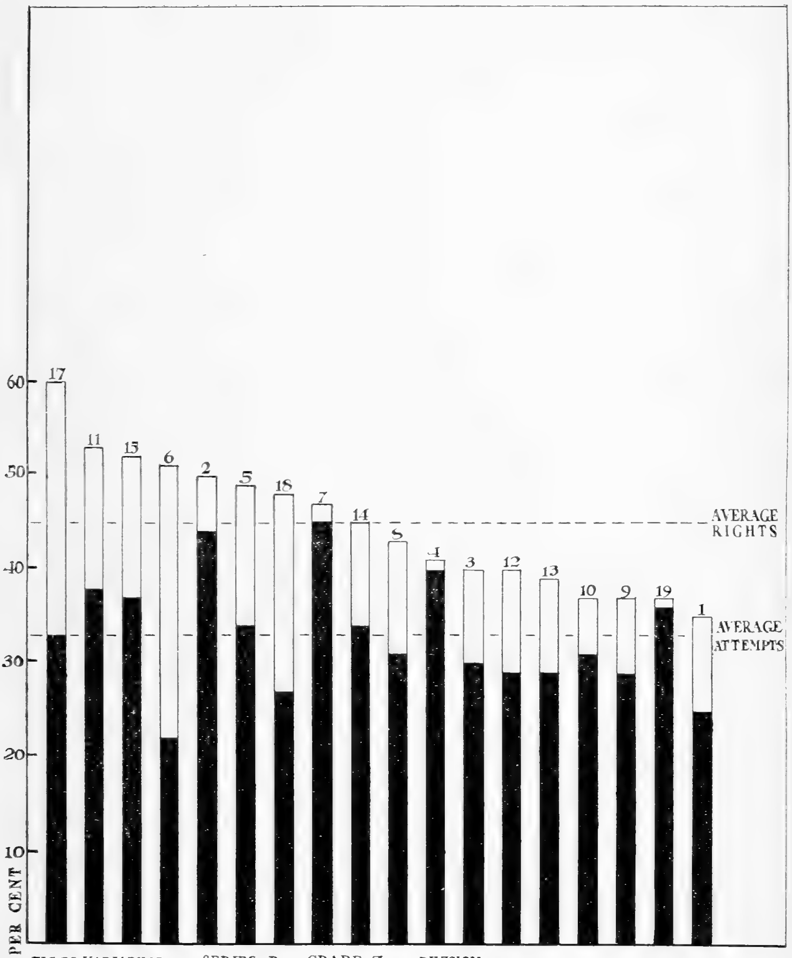

FIG. 28—VARIABILITY SERIES B GRADE 7 DIVISION

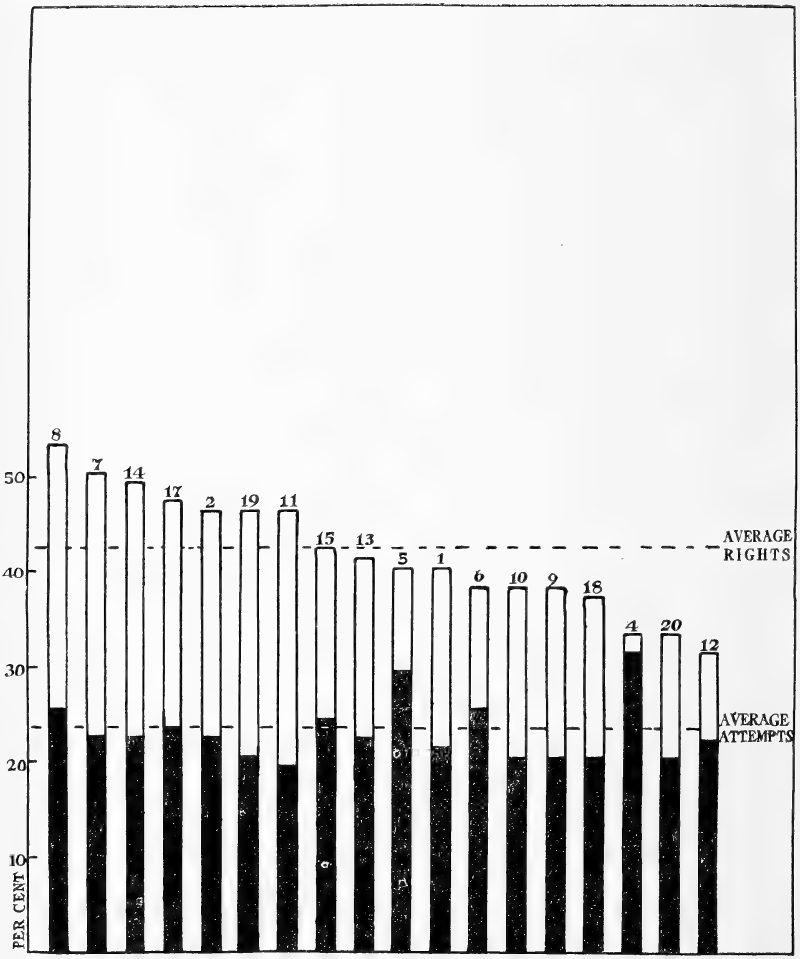

FIG. 29-VARIABILITY SERIES B GRADE 8 ADDITION

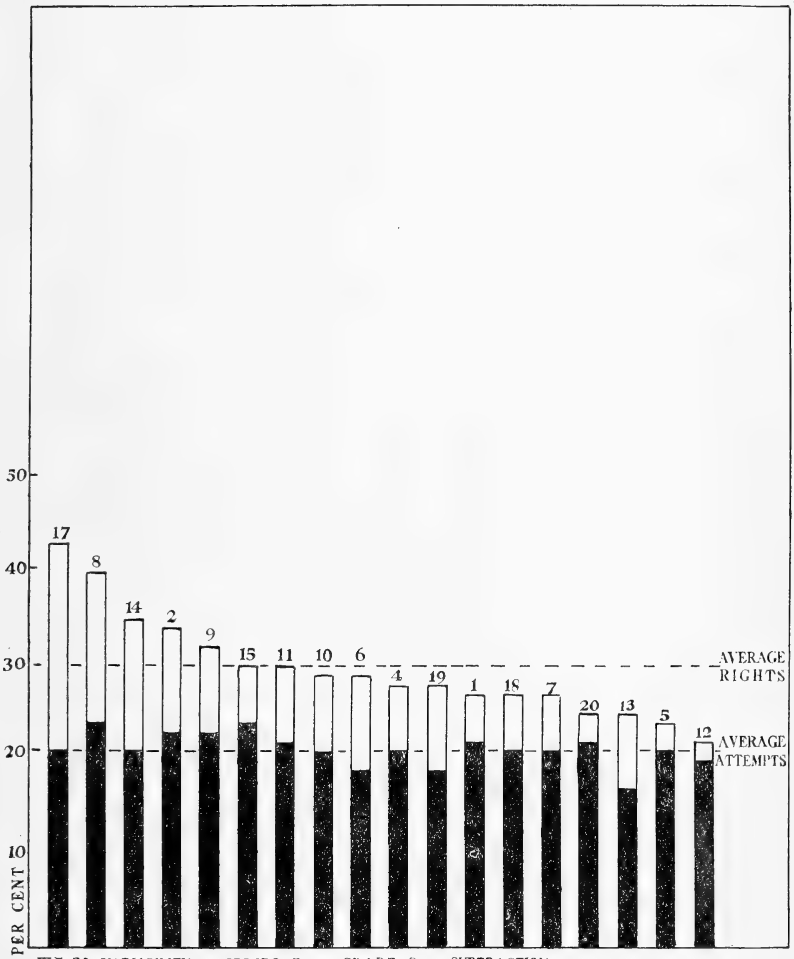

FIG. 30—VARIABILITY SERIES B GRADE 8 SUBTRACTION

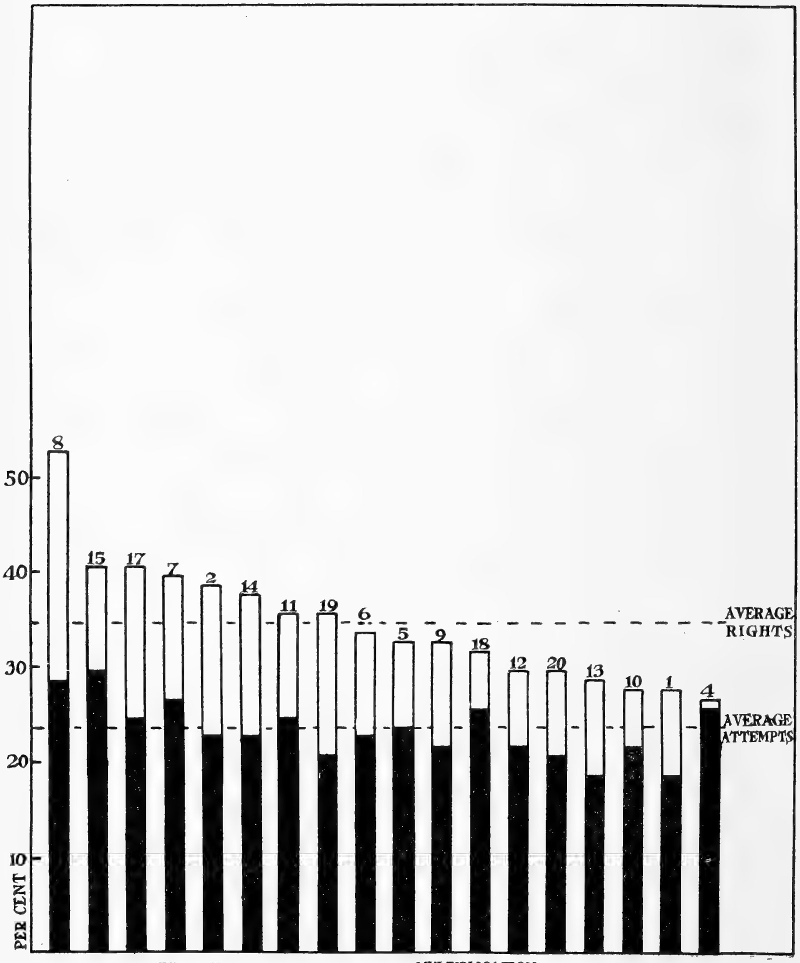

FIG. 31—VARIABILITY SERIES B GRADE 8 MULTIPLICATION

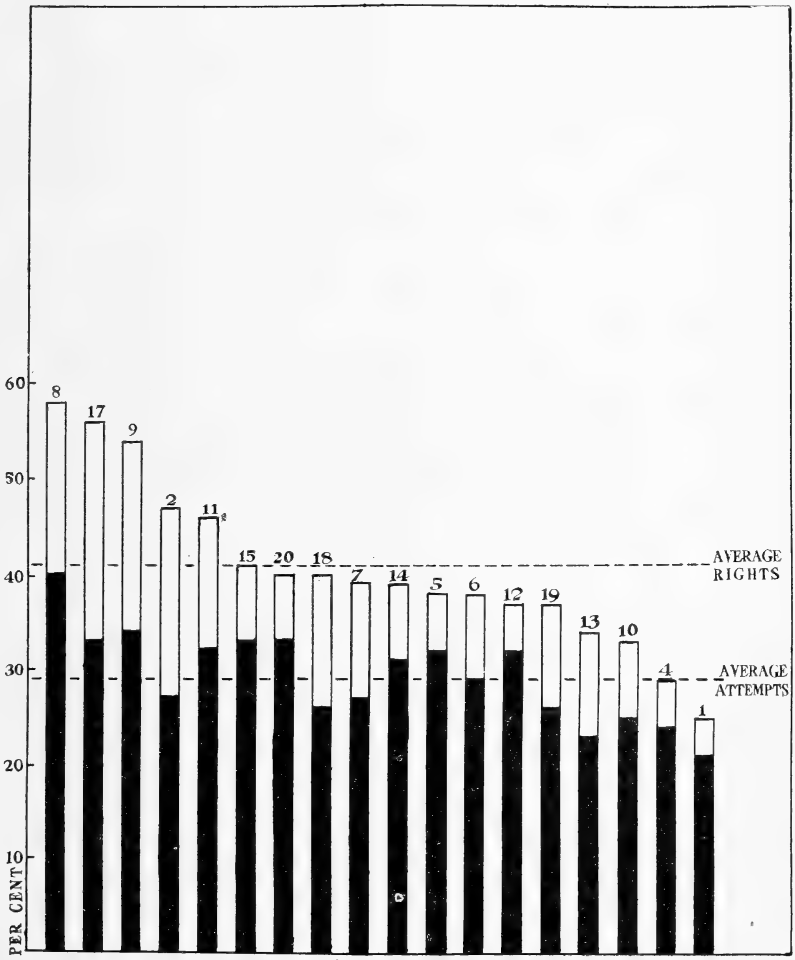

FIG. 32—VARIABILITY SERIES B GRADE 8 DIVISION

DEPENDABILITY

There is still another way in which the results of these tests may be considered as a measure of school work. If a child tries five problems and gets correct results for all the five his work

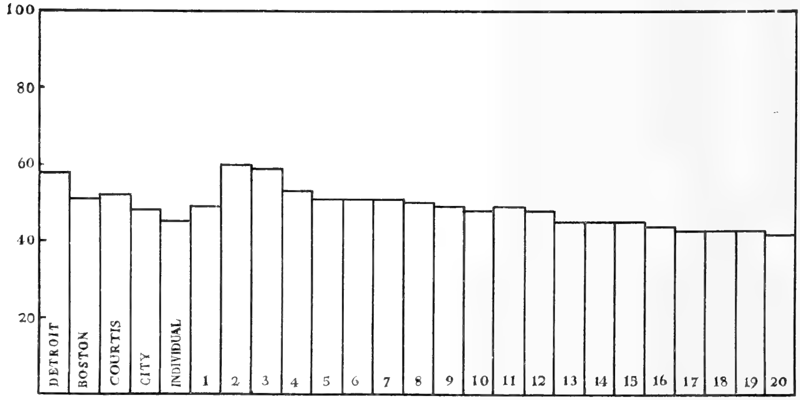

FIG. 33 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 5 ADDITION

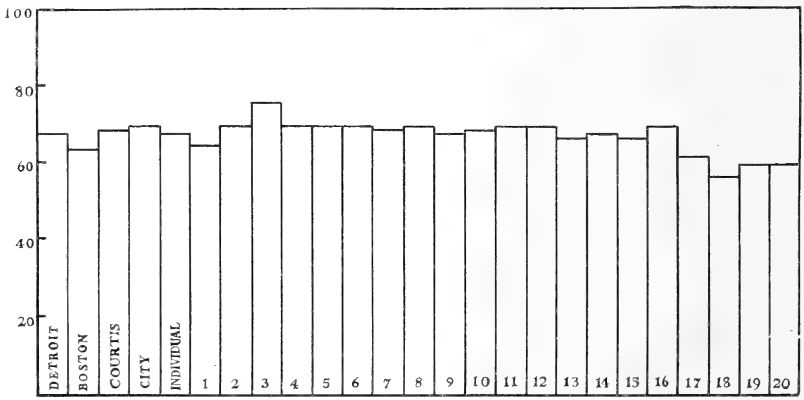

FIG. 34 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 5 SUBTRACTION

may be considered highly dependable. Another child may try five problems and get only two correct. His work is not dependable. It is possible to get a mathematical statement for this fact of dependability by dividing the number of problems correctly solved by the number of problems attempted. By this means the first child may be said to be 100 per cent dependable; the second child

only 40 per cent. Considering each of the cities in each of the sixteen tests and figuring the per cent of dependability we get Table XXXVIII.

In the Form III charts each city is represented by its per cent

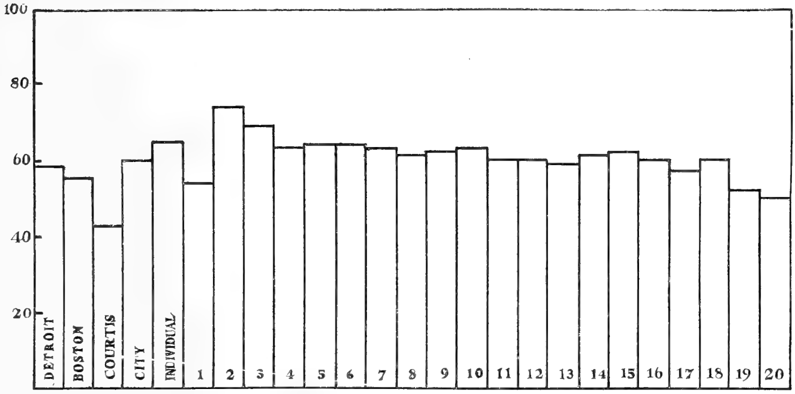

FIG. 35 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES Σ GRADE 5 MULTIPLICATION

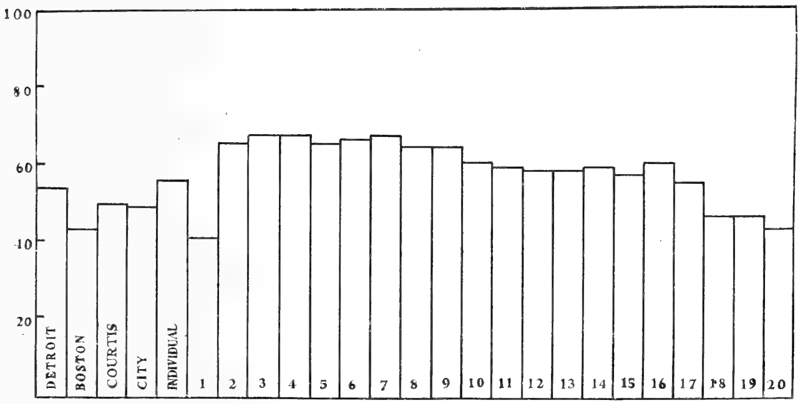

FIG. 36 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 5 DIVISION

of dependability. The horizontal line across the figure at the top indicates 100 per cent. The distance between this line and the top of each column indicates how much that score falls short of 100 per cent. The figures on the left indicate the per cent. The cities are arranged in the same order in which they appear in the tables. To the left appear the columns for Detroit, Boston,

Courtis general, and the Indiana city and individual medians. Then follow the cities in order.

No grade in any city attained more than 91 per cent of dependability. This maximum is attained by city 2, which ranks 20 in

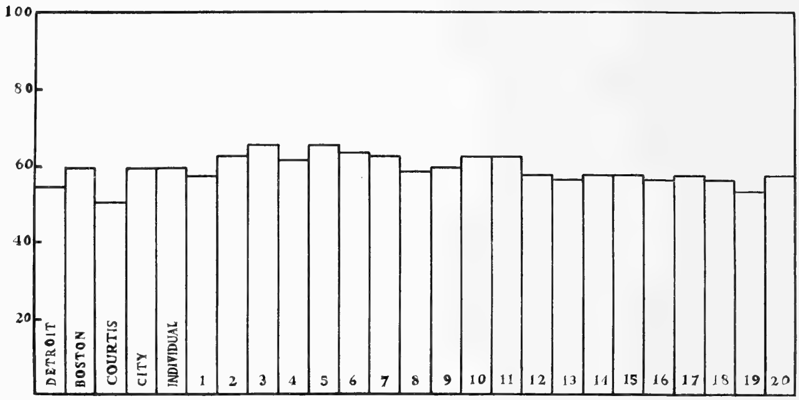

FIG. 37 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 6 ADDITION

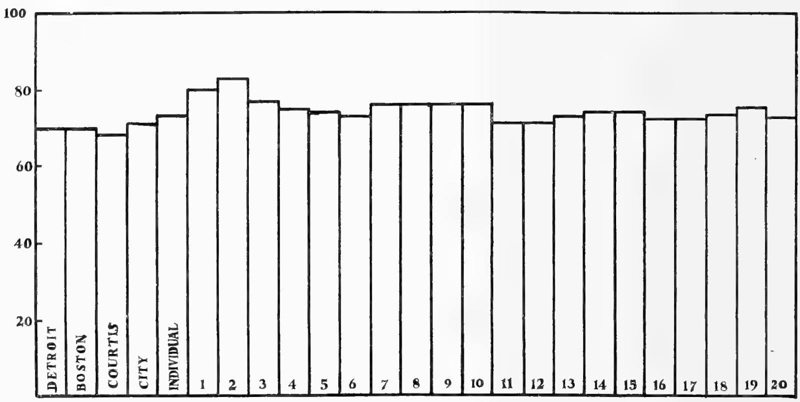

FIG. 38 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 6 SUBTRACTION

both medians and variabilities. In fact this city which ranged so low by the other two measures of efficiency ranks above the average in every point but three, and in six of the sixteen tests actually ranks first. It is also first in composite ranking. City 13, which ranked first in medians, and first in variabilities, drops in fifth grade addition, to rank 2, with a per cent of dependability

of only 65. Its composite rank is 15. City 1, ranking second in medians and sixth in variabilities, here ranks fourteen. Compared with Detroit, Boston, and Courtis general standard, the Indiana city average ranks highest in every grade but eighth, where

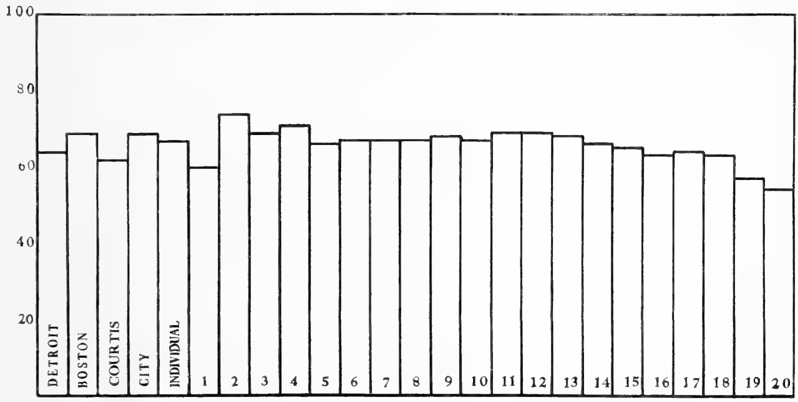

FIG. 39 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 6 MULTIPLICATION

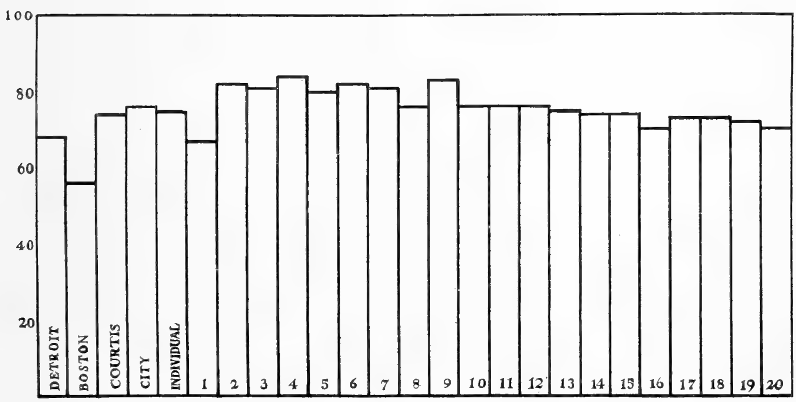

FIG. 40 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 6 DIVISION

it ties Detroit for first place. It is always better than Boston or the Courtis general score. Many of the Indiana cities appear to distinct advantage in comparison.

Taking the four fundamental processes the work in addition appears least dependable of all. The work in division is most dependable except in fifth grade. For the three upper grades the

order from lowest to highest is addition, multiplication, subtraction, and division. The order is slightly different for the fifth grade.

If one considers school progress there is an increase in dependability from grade to grade. This increase is uniform except for

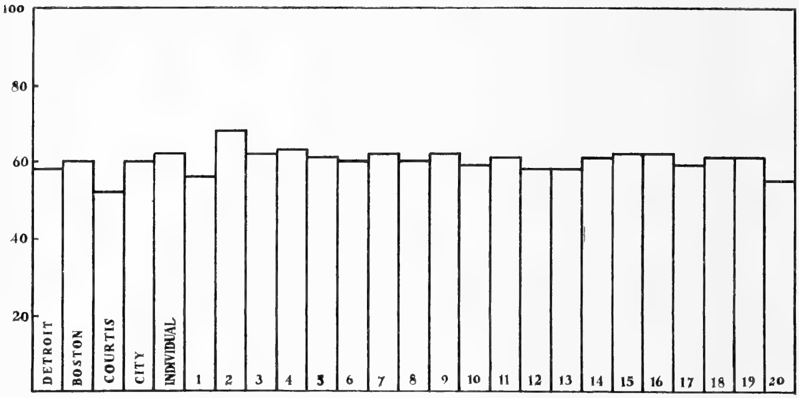

FIG. 41 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 7 ADDITION

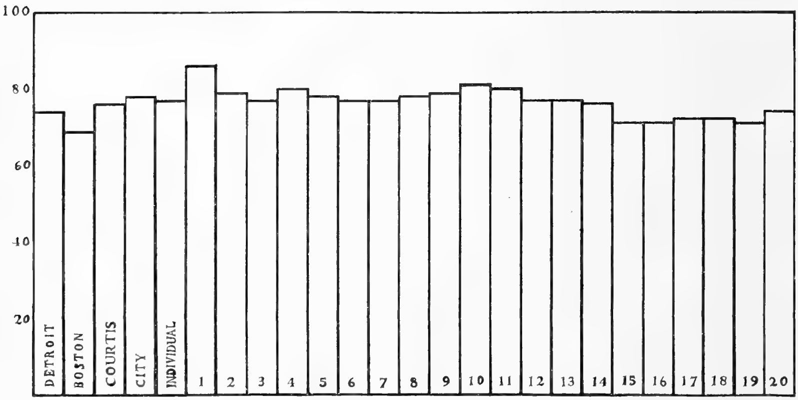

FIG. 42 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 7 SUBTRACTION

a slight inversion in division. At only two places, however, is the increase very considerable. The sixth grade improves over the fifth 4 per cent in addition and 17 per cent in division. Many of the positive changes are very low. One can hardly find encouragement in a change from one grade to another of only 1 per cent, and even 5 per cent or 7 per cent is hardly exciting.

Just what dependability should be required is an open question. In setting his new scores Mr. Courtis assumes 100 per cent accuracy. This is a high requirement which few men attain in any field, even that of exact science. Elementary school children will hardly reach it with ordinary effort. The excessive effort

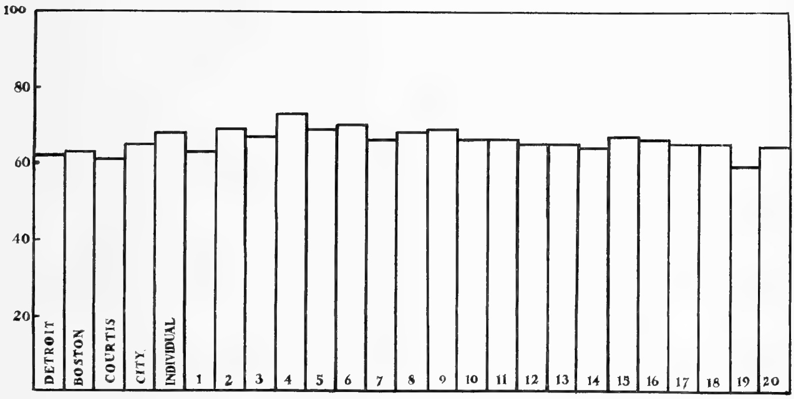

FIG. 43 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 7 MULTIPLICATION

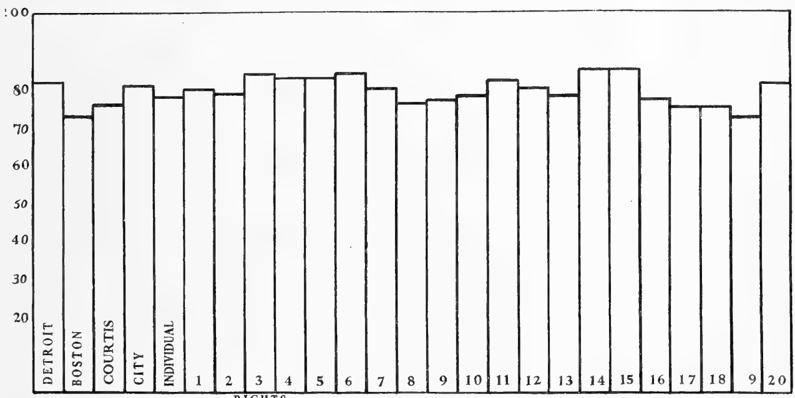

FIG. 44 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 7 DIVISION

necessary to attain such skill is hardly repaid by the returns. Adding machines and methods of checking results easily make up the deficiency. Seventy per cent was the mark in addition for my college class. This was also the record for Boston eighth grade, but no Indiana city reached this mark, nor do any other of Courtis' published scores. In view of these facts a 75 per cent depend-

ability in addition appears a good standard, and 80 per cent would represent an ideal which might be looked upon as satisfactory under present school conditions. In a class making 80 per cent there will, of course, be some who do much better. From this superior group will come the future accountants, bookkeepers,

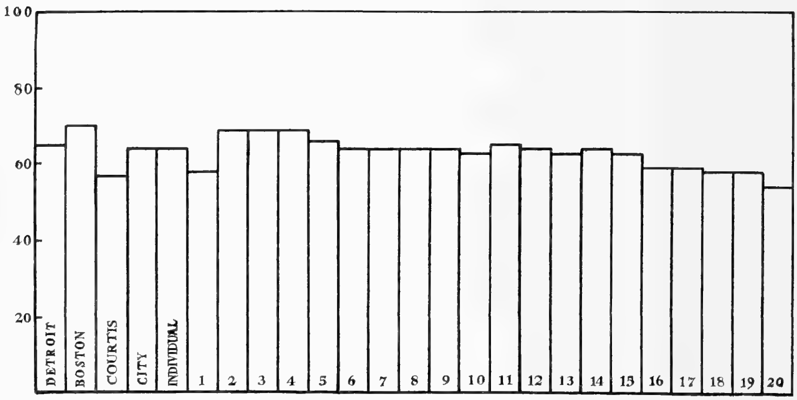

FIG. 45 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 8 ADDITION

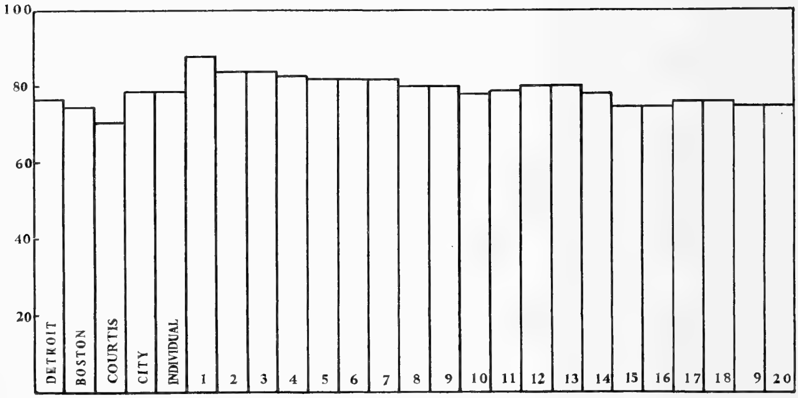

FIG. 46 DEPENDABILITY $\frac{\text{RIGHTS}}{\text{ATTEMPTS}}$ PER CENT SERIES B GRADE 8 SUBTRACTION

etc. The others should be led into other occupations for which they are better adapted.

In Table XXXIX the several cities are ranked as to their dependability. The first column of figures gives the composite ranking for all the tests in all the grades. A careful study of this table would probably show that there is less fluctuation from

grade to grade within a single city than in the case of either medians or variabilities. Comparing the rankings of the cities in dependability with their standing in medians there is an inverse correlation of .46 (method of rank differences). This means that a considerable number of the cities with high median scores

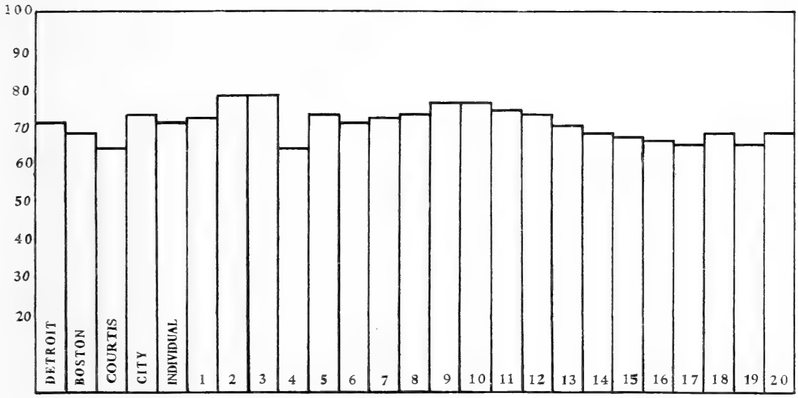

FIG. 47 DEPENDABILITY RIGHTS / ATTEMPTS PER CENT SERIES B GRADE 8 MULTIPLICATION

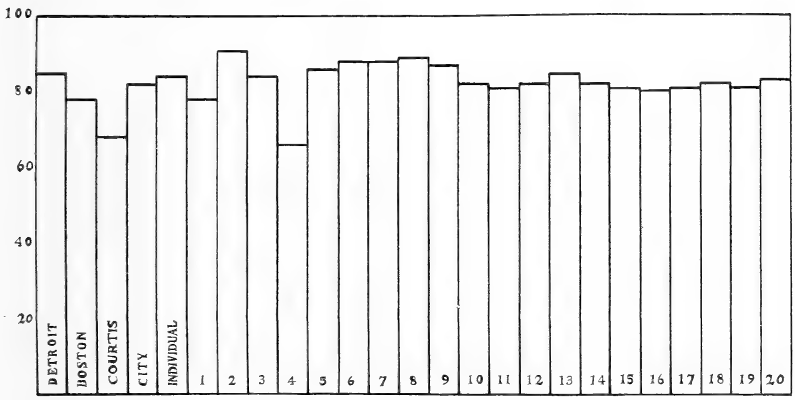

FIG. 48 DEPENDABILITY RIGHTS / ATTEMPTS PER CENT SERIES B GRADE 8 DIVISION

have low rank in dependability, and that some cities with low median scores have high rank in dependability. That the correlation is less than .50 indicates that the inversion is far from absolute. Some cities with fairly high medians also have high dependability. City 3 is a case in point with rank 4 in medians and rank 2 in dependability.

TABLE XXXVIII

DEPENDABILITY—TWENTY CITIES—FOUR GRADES—FOUR TESTS—COMPOSITE SCORE FOR ALL GRADES. ALSO SCORE FOR DETROIT, BOSTON, AND COURTIS GENERAL SCORE (FEBRUARY, 1914)

	GRADE 5				GRADE 6				GRADE 7				GRADE 8				Average	Rank
	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division		
1	.53	.65	.54	.42	.57	.80	.60	.67	.56	.86	.63	.82	.58	.88	.70	.78	.65	15.5
2	.47	.70	.74	.67	.62	.83	.74	.82	.68	.79	.69	.79	.69	.84	.78	.91	.74	1
3	.64	.76	.67	.69	.65	.77	.69	.81	.62	.77	.67	.84	.69	.84	.78	.84	.73	2
4	.62	.70	.63	.69	.61	.75	.71	.84	.63	.80	.71	.83	.69	.83	.64	.66	.70	5.5
5	.56	.70	.64	.67	.65	.74	.66	.80	.61	.78	.69	.83	.66	.82	.73	.86	.72	3
6	.58	.70	.64	.68	.63	.73	.67	.82	.60	.77	.70	.84	.64	.82	.71	.88	.70	5.5
7	.45	.69	.63	.69	.62	.76	.67	.81	.62	.77	.66	.80	.64	.82	.72	.88	.70	5.5
8	.39	.70	.61	.66	.58	.76	.67	. 6	.60	.78	.68	.76	.64	.80	.73	.89	.69	8
9	.50	.68	.62	.66	.59	.76	.68	. 3	.62	.79	.69	.77	.64	.80	.76	.87	.70	5.5
10	.53	.69	.63	.62	.62	.76	.67	.76	.59	.81	.66	.78	.63	.78	.76	.82	.68	10
11	.57	.70	.60	.61	.62	.71	.69	.76	.61	.80	.66	.82	.65	.79	.74	.81	.68	10
12	.61	.70	.60	.60	.57	.71	.69	.76	.58	.77	.65	.80	.64	.80	.73	.82	.68	10
13	.65	.67	.59	.60	.56	.73	.68	.75	.58	.77	.65	.78	.63	.80	.70	.85	.67	13
14	.53	.68	.61	.61	.57	.74	.66	.74	.61	.76	.64	.85	.64	.78	.68	.82	.67	13
15	.54	.67	.62	.59	.57	.74	.65	.74	.62	.71	.67	.85	.63	.75	.67	.81	.67	13
16	.49	.70	.60	.62	.56	.72	.63	.70	.62	.71	.66	.77	.59	.75	.66	.80	.65	15.5
17	.69	.62	.57	.57	.57	.72	.64	.73	.59	.72	.65	.75	.59	.76	.65	.81	.64	17.5
18	.55	.57	.60	.48	.56	.73	.63	.73	.61	.72	.65	.75	.58	.76	.68	.82	.64	17.5
19	.60	.60	.52	.48	.53	.75	.57	.72	.61	.71	.59	.72	.58	.75	.65	.81	.42	19.5
20	.64	.60	.50	.45	.56	.72	.54	.70	.55	.74	.64	.81	.54	.75	.68	.83	.42	19.5
Individual	.55	.68	.61	.57	.59	.73	.67	.74	.62	.77	.68	.78	.64	.79	.71	.84	.67	.....
City	.58	.70	.60	.62	.59	.71	.69	.76	.60	.78	.65	.81	.64	.79	.73	.82	.69	.....
Detroit	.58	.68	.59	.55	.54	.70	.64	.68	.58	.74	.62	.82	.65	.77	.71	.85	.66	.....
Boston	.51	.64	.56	.44	.59	.70	.69	.56	.60	.69	.63	.73	.70	.75	.68	.78	.64	.....
Courtis Standard	.54	.69	.43	.51	.55	.68	.62	.74	.52	.76	.61	.76	.57	.71	.64	.68	.62	.....

TABLE XXXIX

Rank of Twenty Cities in Dependability

	Ranking	Grade 5				Grade 6				Grade 7				Grade 8			
		Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division
1	14	14	16	18	20	13	2	18	20	19	1	19	7½	18	1	11½	19
2	1	18	5½	1	5½	5½	1	1	3½	1	5½	4	12	2	2½	1½	1
3	2	3.5	1	2	2	1½	3	4	5½	5	11	7½	3½	2	2½	1½	8
4	3	5	5½	6	2	8	8½	2	1	2	3½	1	5½	2	4	20	20
5	4	10	5½	3½	5½	1½	11	12½	7	10	7½	4	5½	4	6	7	6
6	6	8	5½	3½	4	3	14	9½	3½	13½	11	2	3½	8½	6	10	3½
7	5	19	10½	6	2	5½	5½	9½	5½	5	11	10½	10½	8½	6	9	3½
8	8	20	5½	10½	7½	10	5½	9½	9½	13½	7½	6	17	8½	9½	7	2
9	7	16	12½	8½	7½	9	5½	6½	2	5	5½	4	15½	8½	9½	3½	5
10	10	14	10½	6	9½	5½	5½	9½	9½	15½	2	10½	13½	13	13½	3½	11½
11	9	9	5½	13½	11½	5½	19½	4	9½	10	3½	10½	7½	5	12	5	15½
12	11	6	5½	13½	13½	13	19½	4	9½	17½	11	14½	10½	8½	9½	7	11½
13	15	2	14½	16	13½	17½	14	6½	12	17½	11	14½	13½	13	9½	11½	7
14	12	14	12½	10½	11½	13	11	12½	13½	10	14	17½	1½	8½	13½	14	11½
15	13	12	14½	8	15	13	11	14	13½	5	19	7½	1½	13	18½	16	15½
16	16	17	5½	13½	9½	17½	17	16½	18½	5	19	10½	15½	15½	18½	17	18
17	18	1	17	17	16	13	17	15	15½	15½	16½	14½	18½	15½	15½	18½	15½
18	17	11	20	13½	17½	17½	14	16½	15½	10	16½	14½	18½	18	15½	14	11½
19	20	7	18½	19	17½	20	8½	19	17	10	19	20	20	18	18½	18½	15½
20	19	3.5	18½	20	19	17½	17	20	18½	20	15	17½	9	20	18½	14	9

PART II

COURTIS TESTS AS AN INSTRUMENT OF RESEARCH: TIME OF BEGINNING ARITHMETIC AND TIME DEVOTED TO ARITHMETIC

General Considerations

It would by no means be fair to condemn or unduly praise a school system on the basis of the results of these tests alone. Many conditions conspire to place any particular city high or low in the group of twenty cities. It is quite possible that some cities have a higher rank in the fundamentals of arithmetic than they would obtain in a similar measurement of their work in reading, spelling, writing, geography, or history. No final judgment can be placed on any school system until such similar measurements in these other fields have been made. In fact until we have the measurements in the whole circle of school tasks we will not know just how much we should expect children of a particular grade to do in arithmetic and at the same time do what they should do in all their other school tasks. It is perfectly certain that the various school subjects must exercise a limiting influence upon each other and determine to a degree the level of efficiency to be set for anyone. Thus what a fifth grade child should do in arithmetic will be in part determined by what he must do in reading and geography. Until we can thus set standards all around we can never be sure that our standards in arithmetic are fair to the child or that in obtaining a very high score in the latter we are not slighting even more important things.

In the absence of such an all-round determination of standard scores there is one other means of determining how efficient a child should become. This is to discover the maximum ability demanded in practical life.

If we could know what is the maximum ability required to "get on" it would set a standard toward which to work. I have tried one such measurement in the case of college students. I gave the Series B tests to sixty-eight students, most of whom were juniors, seniors and graduates. The median scores are shown in Table XL.

TABLE XL

COLLEGE STUDENTS. MEDIAN SCORES

	Attempts.	Rights.
Addition	12.4	9.3
Subtraction	16.6	14.1
Multiplication	11.9	8.7
Division	12.9	12.6

This group included fifteen students who were doing their major work in mathematics, physics, or other subjects where constant practice in the fundamentals of arithmetic is demanded. Dividing the class into two groups, the practiced and unpracticed, and computing the medians for both we get Table XLI.

TABLE XLI

COLLEGE STUDENTS: PRACTICED AND UNPRACTICED. MEDIAN SCORES

	Attempts.		Rights.	
	Practiced.	Unpracticed.	Practiced.	Unpracticed.
Addition	16.1	12.3	13.5	8.7
Subtraction	17.8	15.9	15.3	13.5
Multiplication	12.8	11.5	9.6	8.5
Division	16.7	12.2	16.5	12.

Comparing these results with the medians for the twenty cities we find that the practiced group is very much higher in every case. The superiority of the unpracticed group is not so evident. In both multiplication and division the medians of this group are exceeded by the eighth grades in two or more cities, although most eighth grade classes fall below. The college group, even the unpracticed one, is superior to any eighth grade in addition and subtraction.

If this finding is indicative of a general fact, it means one of two things: either that students who go on to college are above the average ability of eighth grade classes or they continue to improve in these skills after the eighth grade period is over. Probably one or both of these causes operate in a specific case but the fact is evident that the standard of eighth grade achievement must be exceeded in order to become a successful college student.

Miss Baylor, in testing thirteen saleswomen in an Indianapolis department store, found the following median scores: addition, 15-12.5; subtraction, 13-10.4; multiplication, 11.3-7.7; division, 9-6.7. Here, as in the case of the college students, is an evident superiority in addition and subtraction, but in multiplication the

scores are approximately those of the Indiana standard for the eighth grade, and in division there is distinct inferiority.

Mr. Courtis has tested 41 employés in Wanamaker's New York store and other adults. He concludes that the average adult adds at about the standard rate, but found that a group of clerks from the auditing department of the Wanamaker store considerably exceeded the standard. They did not, however, exceed the record of the upper 10 per cent of the children in the New York City schools. Mr. Courtis has also tested adults with a view to discovering whether any relation holds between skill in these tests and one's practical efficiency as measured by his salary. He finds that a correlation exists along the lower salary scale, but that after the latter reaches about twelve hundred dollars per year the correlation disappears. Persons of essentially the same ability in these tests may draw any salary from two thousand to five thousand dollars a year. You have here again an exact quantitative measure as to the maximum of effective skill in the fundamentals of arithmetic.

It seems quite possible that by testing persons who have successfully advanced in various fields we may ultimately determine the standard of work that it is wise to strive for in the public schools. When such a standard has finally been determined it will be incumbent upon teachers and school officers to "show cause" why such a standard should not be met. No less must they justify the overtraining of children. As Mr. Courtis repeatedly insists, "A standard is not only a goal to be reached but also a limit not to be exceeded."

So important is this matter of the limitation of training that I quote from Mr. Courtis at length:

> If, for instance, the average man requires an ability in Test 7 represented by a score of 12 examples in twelve minutes, then it is a waste of time for the child that has reached this degree of development to continue training until he is able to make a score of 24 examples right in twelve minutes. Thirteen clerks in the Actuaries Department of the New York Life Insurance Company, New York City, men and women earning $1,200 a year and upwards, averaged 16 examples right. Five clerks in the auditing department of Wanamaker's Store, New York City, made an average score of 15.4 examples; a group of college professors, superintendents, and teachers in a class at the University of Oklahoma averaged 12.1 examples. The average score of 11,059 eighth grade children was 9.5 examples, which probably represents a reasonable degree of skill for this grade. But 38 per cent of these same eighth grade children had been so overtrained that they exceeded this score by from 10 per cent to 100 per

cent. The upper three per cent of the eighth grade children equalled or exceeded the scores of the adult clerks.

These high scores of school children represent waste effort. Until an adequate control of the fundamental tools by which mental work is done has been acquired, that is, *until* the necessary skill in the Three R's has been developed, *no school work is of greater importance;* but *when* standard ability has been attained, *additional degrees of mechanical skill become products of the least importance.* It is not the function of the public school to develop professional ability at any stage, and the exceptional child should neither be overtrained, just because he is capable of it, nor railroaded through the grades into the complex work of the high school which is of real benefit only to those of more mature tastes and development. The child of meager natural ability must at least attain standard in the fundamentals, even if it takes all his school time; for these are the tools by which his life work will be done. The average child will have time also for applied work designed to develop his initiative and executive ability, his general knowledge, and to inspire him with worthy aims—the really vital work of the school. The exceptional child will spend almost no time in drill; for him the incidental drill of the applied work of any year will so increase his mechanical skill that at the beginning of the next year he will be found to be already of standard ability. Consequently his time can be given wholly to motivated work in a very wide range of industrial and social activities. Such use of standards will aid each child, whatever his natural ability, to make a year's progress in the type of work of which he is capable in a year's time. Each child will attempt only the problems which represent what are for him the next steps of advance, and each child will learn in the *peculiar way that best suits his personality.* The product will be uniform in the sense that every graduate of the school will be able to perform various fundamental activities at very closely the same rate and with about the same degree of accuracy, but the product will be diverse in the sense that the uniform skill will have been developed in very different ways, and that it will be used by different individuals for very different ends. Street car conductors, mechanics, artists, poets, statesmen, all make use of arithmetic, and all need to do so efficiently. The engineer and the professional accountant, and certain other special types of workers, it is true, need more extended training and higher degrees of skill. Uniformity must, therefore, end at the point in the course of study where vocational guidance and specialization become effective. But so far as abilities are truly fundamental, whether in arithmetic or in other subjects, a uniform product attained by careful development of the individual is the one means by which efficiency in all school work can be made possible.[2]

Dr. J. M. Rice[3] concluded from his studies in arithmetic that having a definite standard and testing for results was the determining factor in securing high scores. He held that the responsibility for setting such standards rested upon the supervisory force

[2] Courtis, S. A. *Second Annual Accounting. Bulletin Number Two* (Detroit, 1913).

[3] Rice, J. M. *Scientific Management in Education* (New York, 1913).

and ultimately upon the superintendent. In the light of this conclusion, the general standard determined by results obtained under widely different conditions becomes vastly important.

It is not sufficient, however, to discover what the final goal of achievement should be. It is equally important to determine what part of the whole achievement should be attained by each grade. Mr. Courtis has tried to set both the ultimate standards and the individual grade standards. His present statement may not prove final. It is a great advance to have these definite aims even though further study may alter them in detail.

Even when we have determined what the standard score should be we cannot condemn a school system for not meeting this standard without a thorough study of the causes operating to determine the particular score made. In fact it is quite likely that the most important result forthcoming from the use of standard tests will be an exact quantitative study of the causes which determine school products. It is worth while to measure a pupil, a class, a school, a city, or twenty cities, and discover that you can give the subject of your measurement a rank in relation to a standard score. It is worth very much more to the science of education if by making such measurements you can discover the conditions which induce to the high or low score of the subject measured. And just this latter desirable issue is what the use of the standard tests promises.

Take the case in hand. What any child or group of children do with the Courtis Arithmetic Tests, Series B, is the resultant of two forces, the inherited qualities of the children and the environmental conditions, remote and immediate, under which they have lived. From our studies of heredity we now know that tall fathers are much more likely to have tall sons than are fathers of small stature. It is quite likely that arithmetical ability is likewise inherited. There is an accumulating body of evidence to show that this is so. With the advent of standardized tests we have the means of determining the extent to which such inheritance is a fact. Until we have made the determination we cannot be sure how to place the responsibility for the particular scores made nor be clear as to the effect of books, methods, or teachers. In view of the very probable effect of inherited qualities it is not at all clear how this factor functions in the several cities here reported. If East Chicago has a large foreign population and Kendallville has a homogeneous native population, the resultant scores in the two

cities may be very largely affected thereby. Just how, we cannot tell without an extended study. We do not yet know whether Hungarian immigrants are deficient in arithmetical ability, or whether the German settlers are highly proficient, or whether the third generation of New England emigrants are better or worse than either. It is hopeful, however, that the standardized tests give us the means for settling the question.

In order to envisage the possible service of educational measurements in a clear way it may not be amiss to enumerate some of the *environmental* causes operating to produce the scores reported in this monograph. Suppose we state these causes as problems for solution. What is the relation of a high score to any one of the following conditions: Time of beginning the study of arithmetic? School time devoted to arithmetical study? Departmental teaching? Professional training of teachers? Salaries paid teachers? Salary of superintendent? Supervision by superintendent, principal, or supervisor? Particular textbooks and particular methods of instruction? Size of classes? Student self-government or military discipline? Home study or assembly room study? Supervised study period? Accurate grading as by per cent or general grading as by letters? Keeping grades secret or sending monthly reports to parents? Parent-teachers' meetings? Discouragement or encouragement by the teacher? Emphasis on accuracy or speed or both? Solution of long problems demanding analytic study? Drill on fundamental process? And so on through the long list of conditions which from time to time are advanced as explanations for good or bad school products. For the solution of every one of these problems the employment of standard tests is promising. Wide and extended investigations will be necessary, but the result is sure.

In the present study we have some data to offer on two of the problems suggested above, the time of beginning and the amount of time spent on the study of arithmetic.

In order to get accurate data in these fields the superintendents of the schools reporting filled out a questionnaire submitted by the University. It will be best to discuss each of these topics separately.

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A. Time of Beginning Arithmetic

The questionnaire submitted on this topic was as follows:

TIME OF BEGINNING STUDY OF ARITHMETIC

City Reporting ....

Indicate the time when each class began the study of arithmetic. In order that results may be uniform, consider a class as beginning arithmetic the term when the first arithmetic grades were given. If your records are complete, this should be an easy matter. If records are at fault, estimate as accurately as possible and place estimate after your mark.

Eighth grade ....

Seventh grade ....

Sixth grade ....

Fifth grade ....

Each of the twenty cities returned the questionnaire complete. As a result we have the school year when each class reported in the tests began its arithmetic study in the school. This varies from city to city and at times from grade to grade within the same city. Thus one city reported that its eighth grade began arithmetic in the first grade, but the fifth grade began in grade two. We are able here to bring together the scores for all fifth grade classes which began their work in the first grade, for all who began in the second grade, and for all who began in the third grade. No city reported a class in any grade beginning as late as the fourth grade. In Tables XLII to XLIV are gathered together all the data resulting from this questionnaire. The first three horizontal rows of figures of Table XLII are the medians. Reading across the table: Fifth grade children beginning their work in the first year of school, addition, attempts 6.9, rights 3; subtraction, attempts 7.5, rights 5.3, etc.; the total number of children included being 492. The second and third rows are for children beginning arithmetic in the second and third years of school respectively. Then follow to the right similar data for sixth, seventh, and eighth grades.

Immediately below the medians are the ranks for the three groups in the several points, and at the extreme right are the ranks for each of the four grades and for the total of all grades.

Similarly the variabilities and the ranks in variabilities follow on the lower part of the table.

If one judges by the tables of ranks it is clearly best for children

to begin school work in arithmetic in the second year. In every case the second-year beginners rank first for the total for each grade and for the total for all grades. This holds both in medians and in variabilities. The second best are the first-year beginners, and the third-year beginners are the poorest of all. But one exception offers to this generalization, namely, in seventh grade medians where the third-year beginners outrank the first-year beginners.

If one goes back to the rankings in the several points the superiority of the second-year beginners is not so clearcut. In thirteen of the thirty-two median rankings the second-year beginners are equalled or outranked by one of the other groups. Their superiority is most distinct in seventh grade and least so in the eighth. In the latter they are first but three of the eight times. Even less distinction attaches to the first rank if one goes farther back, to the difference in the medians which gives the rank. A difference of .1 will give superiority in rank but it is highly questionable whether a difference of .1 is a significant difference. As a matter of fact second-year beginners get their first rank in sixteen cases out of nineteen by a superiority over the next highest group of not to exceed .5. Thus while the second-year beginners have a clear right to first place, the margin of this excellence is so slight that one may reasonably question whether or not it is not due to other causes than the time of beginning. It would not be at all surprising if another ten thousand children should show a superiority for first-grade or even third-grade beginners.

Similarly the variabilities of the three groups are somewhat equivocal as to meaning. Here again, when one considers the total, second-year beginners rank first; first-year, second; and third-year, third. But going back to the rankings in individual points one finds second-year beginners first in but fifty per cent of the cases. Third-year beginners are first twice, first year beginners twelve times, and first and second tie twice. Going back to the variabilities themselves one sees again how slight a margin avails to give superior rank. Seventeen times in ninety-six it is two per cent or less. It is quite possible that a much larger number of children would show a different order for the three periods of beginning.

The tables of dependabilities (XLIII and XLIV) do not indicate different conclusions. Second-year beginners rank first in the greatest number of tests and also in the composite ranking. The margin of excellence is slight, however, in many cases. In

almost half it is not over 5 per cent. Such differences may be due to causes quite adventitious and are not necessarily connected with the time of beginning.

Further doubt is thrown upon the value of second-year beginning by the results from the Bloomington schools (see page 505 ff.) where the arithmetic work is begun in the third year. The Bloomington returns are not only superior to the Indiana standard but are equal to and in most cases superior to the average of second-year beginners. From this one sees that however important the time of beginning really is, it is not the determining thing. A school can achieve superior results by beginning in the third year.

It is quite probable that the results of this inquiry which show second-year beginners to be strongest will not finally stand. It is a tentative statement and we can doubtless in time show similar studies in which third-grade beginners are superior. It must be admitted, of course, that the burden of proof is upon him who denies the plain figures of Table XLII. Excellence in arithmetic, however, is dependent upon causes other than the time of beginning. A proper grasp of these more important causes makes the time of beginning merely adventitious. One of these more fundamental causes I shall discuss later (pages 505-507).

TABLE XLII

SCORES OF CHILDREN BEGINNING THE STUDY OF ARITHMETIC IN FIRST, SECOND AND THIRD GRADES. FIRST PART: MEDIAN SCORES; SECOND PART: RANK IN MEDIAN SCORES; THIRD PART: VARIABILITIES; FOURTH PART: RANK IN VARIABILITIES

YEAR OF BEGINNING	Grade 5									Grade 6								
	Addition		Sub-traction		Multipli-cation		Division		Total No. of children	Addition		Sub-traction		Multipli-cation		Division		Total
	Attempss	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights		Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	
MEDIANS																		
First	6.9	3	7.5	5.3	6.5	4.1	4.6	2.8	492	6.4	4.2	8.9	6.9	7.9	5	6.1	4.5	336
Second	6.7	3.7	7.7	5.2	6.7	3.6	4.6	2.8	1,507	7.6	4.6	8.9	7	7.6	5.4	6.8	6.2	1,594
Third	6.4	3.3	7.2	4.6	5.1	3.5	4	2.1	625	7.3	3.9	9.2	6.1	7.3	4.6	6.3	4	607
RANK IN MEDIANS																		
First	1	3	2	1	2	1	1.5	1.5	.....	3	2	2.5	2	1	2	3	2	.....
Second	2	1	1	2	1	2	1.5	1.5	.....	1	1	2.5	1	2	1	1	1	.....
Third	3	2	3	3	3	3	3	3	.....	2	3	1	3	3	3	2	3	.....
VARIABILITY																		
First	14	77	24	40	15	34	43	79	.....	23	57	21	33	24	48	44	64	.....
Second	27	57	23	25	27	58	41	79	.....	25	29	24	36	28	31	38	51	.....
Third	31	64	24	54	41	56	48	100	.....	29	56	25	39	32	43	48	73	.....
RANK IN VARIABILITY																		
First	1	3	2.5	2	1	1	2	1.5	.....	1	3	1	1	1	3	2	2	.....
Second	2	1	1	1	2	2	1	1.5	.....	2	1	2	2	2	1	1	1	.....
Third	3	2	2.5	3	3	3	3	3	.....	3	2	3	3	3	2	3	3	.....

TABLE XLII Continued

SCORES OF CHILDREN BEGINNING THE STUDY OF ARITHMETIC IN FIRST, SECOND AND THIRD GRADES. FIRST PART: MEDIAN SCORES; SECOND PART: RANK IN MEDIAN SCORES; THIRD PART: VARIABILITIES; FOURTH PART: RANK IN VARIABILITIES

YEAR OF BEGINNING	GRADE 7									GRADE 8									RANKS				
	Addition		Subtraction		Multiplication		Division			Addition		Subtraction		Multiplication		Division							
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Total	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	Total	Grade 5	Grade 6	Grade 7	Grade 8	All
MEDIANS																							
First	7.9	4.6	9.9	7.6	8.4	5.5	8.1	6.1	394	8.7	5.4	11.4	9	10.3	7.1	10.1	8.5	359	...	...	...	...	...
Second	8.3	5.3	10.2	8.1	8.8	6.2	8.8	7.4	1,141	9.1	5	11.2	9	10.1	7.4	10.4	9.4	985	...	...	...	...	...
Third	7.9	4.6	10.4	7.6	8.3	5.5	8.3	6.6	376	9.1	5.7	10.7	8.5	10.5	7.2	9.6	7.8	302	...	...	...	...	...
RANK IN MEDIANS																							
First	2.5	2.5	3	2.5	2	2.5	3	3	...	3	2	1	1.5	2	3	2	2	...	2	2	3	2	2
Second	1	1	2	1	1	1	1	1	...	1.5	3	2	1.5	3	1	1	1	...	1	1	1	1	1
Third	2.5	2.5	1	2.5	3	2.5	2	2	...	1.5	1	3	3	1	2	3	3	...	3	3	2	3	3
VARIABILITY																							
First	24	50	21	34	29	45	29	54	...	23	46	23	30	23	38	39	44	...	...	...	...	...	...
Second	25	45	24	31	26	39	33	41	...	24	48	23	30	25	32	32	37	...	...	...	...	...	...
Third	25	50	22	33	28	45	39	48	...	26	40	21	31	25	38	33	45	...	...	...	...	...	...
RANK IN VARIABILITY																							
First	1	2.5	1	3	3	2.5	1	3	...	1	2	2.5	1.5	1	2.5	3	2	...	2	2	2	2	2
Second	2.5	1	3	1	1	1	2	1	...	2	3	2.5	1.5	2.5	1	1	1	...	1	1	1	1	1
Third	2.5	2.5	2	2	2	2.5	3	2	...	3	1	1	3	2.5	2.5	2	3	...	3	3	3	3	3

TABLE XLIII

TIME OF BEGINNING: PER CENT OF DEPENDABILITY

	Grade 5				Grade 6				Grade 7				Grade 8			
	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division
First Year	.43	.70	.63	.60	.65	.77	.63	.73	.58	.76	.63	.75	.62	.78	.68	.84
Second year	.55	.67	.53	.60	.60	.79	.71	.91	.63	.79	.70	.84	.54	.80	.80	.90
Third year	.51	.63	.68	.52	.53	.66	.63	.63	.58	.73	.66	.79	.62	.79	.79	.81

TABLE XLIV

TIME OF BEGINNING: RANK IN DEPENDABILITY

	Grade 5				Grade 6				Grade 7				Grade 8				Rank in All Tests
	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	
First year....	3	1	2	1½	1	2	2½	2	2½	2	3	3	1½	3	2½	2	2
Second year...	1	2	3	1½	2	1	1	1	1	1	1	1	3	1	1	1	1
Third year....	2	3	1	3	3	3	2½	3	2½	3	2	2	1½	2	2½	3	3

B. TIME DEVOTED TO ARITHMETIC

How much time is it profitable to spend on arithmetic? It did not seem safe to trust here to estimates of the total amount of time spent by each grade, so a detailed questionnaire was used as follows:

TIME DEVOTED TO ARITHMETIC

City Reporting ....

Report here both the time devoted to study and the time devoted to recitation. Give data in terms of minutes per week. In computing results a school year of 36 weeks will be assumed. If your school year varies from this, indicate that fact. Give data for each class separately, as follows:

Eighth Grade

Minutes per Week	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.	Sixth Year.	Seventh Year.	Eighth Year.
Study								
Recitation								
Total								

Seventh Grade

Minutes per Week	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.	Sixth Year.	Seventh Year.
Study							
Recitation							
Total							

Sixth Grade

Minutes per Week	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.	Sixth Year.
Study						
Recitation						
Total						

Fifth Grade

Minutes per Week	First Year.	Second Year.	Third Year.	Fourth Year.	Fifth Year.
Study					
Recitation					
Total					

As in the former case, all of the cities returned the questionnaire. Inasmuch as the superintendents reporting have, for the most part, been in intimate touch with their school systems for a considerable length of time, the data derived from this questionnaire are unusually dependable, and we have assumed them to be correct. Table XLV represents the results of the questionnaire by city and grade.

TABLE XLV

NUMBER OF MINUTES SPENT IN ARITHMETIC WORK BY THE FOUR GRADES IN EACH OF THE TWENTY CITIES UP TO THE TIME OF TAKING THE TEST.

CITY.	Grade 5	Grade 6	Grade 7	Grade 8
1	26,280	33,480	42,480	51,480
2	25,200	32,400	41,400	50,400
3	28,800	37,800	48,600	59,400
4	29,232	37,332	48,564	60,444
5	28,800	39,600	55,800	68,040
6	29,160	39,960	50,760	61,560
7	33,300	38,700	40,500	49,600
8	19,800	30,600	41,400	52,200
9	28,800	37,800	48,600	59,400
10	23,400	34,200	43,200	52,200
11	34,740	43,740	52,740	61,740
12	30,600	41,400	50,400	59,400
13	30,600	41,400	52,200	63,000
14	25,560	32,760	40,680	48,600
15	63,900	83,700	90,900	98,100
16	27,000	36,000	50,400	61,200
17	44,100	52,200	57,600	63,000
18	36,900	47,700	58,500	70,200
19	27,000	36,000	48,600	59,400
20	35,100	45,000	55,800	66,600

In Table XLVI the pupils reported are grouped into classes depending on time spent. Sixteen classes are indicated. Class 1 includes all pupils who had spent less than 25,000 minutes up to the time of being tested. Classes 2 to 16 differ each from the one next to it by 5,000 minutes. Children are found in each class excepting 12 and 14. The figures before the dash indicate the number of schools reporting pupils in a particular class; the figures after the dash are for the number of individuals reported.

That the amount of time spent varies greatly is evident on a hasty glance at the table. In every grade one or more schools is giving almost double the amount of time spent by the average of the twenty cities. In the fifth grade one city gives almost three times what two others give. If such different time distributions are really important there should appear distinct differences in the medians, and variabilities of the cities which follow different methods. The facts as to this are shown in tables XLVII to LII.

TABLE XLVI

CLASSES OF PUPILS BASED ON TOTAL TIME SPENT ON ARITHMETIC UP TO TIME OF TAKING TEST. (FIGURES BEFORE DASH INDICATE NUMBER OF CITIES; FIGURES AFTER DASH INDICATE NUMBER OF CHILDREN.)

Class	Minutes	Fifth Grade	Sixth Grade	Seventh Grade	Eighth Grade	Total
1.	0 to 25,000	2–302	0	0	0	2
2.	25,000 to 30,000	10–1,530	0	0	0	10
3.	30,001 to 35,000	4–388	5–648	0	0	9
4.	35,001 to 40,000	2–102	8–1,144	0	0	10
5.	40,001 to 45,000	1–91	3–348	6–493	0	10
6.	45,001 to 50,000	0	2–97	4–544	2–104	8
7.	50,001 to 55,000	0	1–84	5–470	4–298	10
8.	55,001 to 60,000	0	0	4–237	4–469	8
9.	60,001 to 65,000	1–211	0	0	6–486	7
10.	65,001 to 70,000	0	0	0	2–101	2
11.	70,001 to 75,000	0	0	0	1–65	1
12.	75,001 to 80,000	0	0	0	0	0
13.	80,001 to 85,000	0	1–209	0	0	1
14.	85,001 to 90,000	0	0	0	0	0
15.	90,001 to 95,000	0	0	1–167	0	1
16.	95,001 to 100,000	0	0	0	1–123	. . . .

Table XLVII shows the medians for each of the sixteen classes and the four grades. Table XLVIII is a table of ranks based on the medians of Table XLVII. Studying the ranking table one is struck by the fact that first rank in no case goes to the pupils spending the most time on arithmetic. The optimal time apparently falls between two extremes.

In three grades the final rank for the grade gives first place to the class spending the second greatest amount of time. In grade seven first rank goes to the class spending next to the least amount of time. And in every grade the placing of second and third rank indicates that excellence may be obtained without the excessive amount of time spent by many schools. Fourth, fifth, sixth, and in one case seventh, rank goes to schools giving more than average time to arithmetic. What defense is to be made for school systems giving 65,000 minutes to the study of arithmetic before the end of the fifth grade while another group of schools achieve better work with less than 35,000 minutes devoted to the subject, or what is to be said for the teachers of 486 eighth grade children

TABLE XLVII

TIME SPENT: MEDIAN SCORES OF CHILDREN IN DIFFERENT CLASSES

NUMBER OF MINUTES	Grade 5									Grade 6								
	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights		Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	
0— 25,000	6.5	2.9	7.1	4.1	5.8	3.1	4.3	2	302	....	....	....	....	....	....	....	....	....
25,001— 30,000	6.5	3.7	7.3	5.1	6.3	3.9	4.4	2.6	1,530	....	....	....	....	....	....	....	....	....
30,001— 35,000	6.9	3.8	7.5	5.5	6.7	4.5	4.5	2.9	388	7.7	4.4	9.2	5.9	7.6	4.9	6.3	4.5	648
35,001— 40,000	6.5	3.8	7	5	6.7	4.3	4.9	3.4	102	6.8	4.4	8.8	6.4	7.5	5.2	6.7	4.9	1,144
40,001— 45,000	7.6	5.3	7.6	6.3	6.9	5	5.2	3.9	91	7.3	4.3	9.6	7.9	8.9	5.6	6	4.6	348
45,001— 50,000	....	....	....	....	....	....	....	....	....	7.1	4.3	10	6.5	7.3	5	6.3	5.2	97
50,001— 55,000	....	....	....	....	....	....	....	....	....	7.9	5.2	8.5	6.8	7.5	5.4	7.1	6.5	84
55,001— 60,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
60,001— 65,000	6.8	3.7	7.5	4.8	6.1	3.3	4.8	2.7	211	....	....	....	....	....	....	....	....	....
65,001— 70,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
70,001— 75,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
75,001— 80,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
80,001— 85,000	....	....	....	....	....	....	....	....	....	7.9	4.6	8.5	6.3	7.2	5.1	6.4	4.8	209
85,001— 90,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
90,001— 95,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
95,001—100,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

TABLE XLVII—Continued

TIME SPENT: MEDIAN SCORES OF CHILDREN IN DIFFERENT CLASSES

NUMBER OF MINUTES	Grade 7									Grade 8								
	Addition		Subtraction		Multiplication		Division		Total No. of Pupils	Addition		Subtraction		Multiplication		Division		Total No. of Pupils
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights		Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	
0— 25,000																		
25,001— 30,000																		
30,001— 35,000																		
35,001— 40,000																		
40,001— 45,000	8.3	4.8	10.6	8.1	9.5	5.9	8.6	7.1	493									
45,001— 50,000	8.3	5.5	10	8.4	9.1	6.2	9.2	7.7	544	8.7	5.3	11.3	8.6	9.8	6.8	9.8	8	104
50,001— 55,000	7.8	4.6	9.8	7.4	7.9	5.1	7.8	6.1	470	9.5	5.7	11.9	9.2	11	8	11.5	9.4	298
55,001— 60,000	7.8	5.1	10.8	8.2	8.6	6	8.6	7.2	237	9.2	6.3	11.3	9.3	10.5	7.1	10.5	9.9	469
60,001— 65,000										8.7	5.4	10.6	8.3	10.1	6.8	9.4	7.9	486
65,001— 70,000										8.4	5.9	10.2	10.1	10.3	7.3	11	9.5	101
70,001— 75,000										9.4	6.1	13	11	10	7.8	11.9	10.3	65
75,001— 80,000																		
80,001— 85,000																		
85,001— 90,000																		
90,001— 95,000	8.6	4.9	10.1	7.1	7.8	4.4	8.6	7.1	167									
95,001—100,000										8.9	5.8	10.7	8	9.4	6.5	9.9	8.5	123

TABLE XLVIII

TIME SPENT: RANKS BASED ON TABLE XLVII

NUMBER OF MINUTES	Grade 5										Grade 6									
	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Final Ranking	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Final Ranking
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights			Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights		
0— 25,000	5	6	5	6	6	6	6	6	320	6	...	...	...	...	...	...	...	...	...	...
25,001— 30,000	5	4.5	4	3	4	4	5	5	1,530	5	...	...	...	...	...	...	...	...	...	...
30,001— 35,000	2	2.5	2.5	2	2.5	2	4	3	388	2	3	3.5	3	6	2	6	4.5	6	648	6
35,001— 40,000	5	2.5	6	4	2.5	3	2	2	102	3	6	3.5	4	4	3.5	3	2	3	1,144	3
40,001— 45,000	1	1	1	1	1	1	1	1	91	1	4	5.5	2	1	1	1	6	5	348	2
45,001— 50,000	...	...	...	...	...	...	...	...	...	...	5	5.5	1	3	5	5	4.5	2	97	4.5
50,001— 55,000	...	...	...	...	...	...	...	...	...	...	1.5	1	5.5	2	3.5	2	1	1	84	1
55,001— 60,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
60,001— 65,000	3	4.5	2.5	5	5	5	3	4	211	4	...	...	...	...	...	...	...	...	...	...
65,001— 70,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
70,001— 75,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
75,001— 80,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
80,001— 85,000	...	...	...	...	...	...	...	...	...	...	1.5	2	5.5	5	6	4	3	4	209	4.5
85,001— 90,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
90,001— 95,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
95,001—100,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE XLVIII—Continued

TIME SPENT: RANKS BASED ON TABLE XLVII

NUMBER OF MINUTES	Grade 7										Grade 8									
	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Final Ranking	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Final Rank
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights			Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights		
0— 25,000																				
25,001— 30,000																				
30,001— 35,000																				
35,001— 40,000																				
40,001— 45,000	2.5	4	2	3	1	3	3	3.5	493	3										
45,001— 50,000	2.5	1	4	1	2	1	1	1	544	1	5.5	7	3.5	5	6	5.5	6	6	104	6
50,001— 55,000	4.5	5	5	4	4	4	5	5	470	5	1	5	2	3.5	1	1	2	4	298	2
55,001— 60,000	4.5	2	1	2	3	2	3	2	237	2	3	1	3.5	3.5	2	3	4	2	469	3
60,001— 65,000											5.5	6	6	6	4	5.5	7	7	486	7
65,001— 70,000											7	3	7	2	3	4	3	3	101	4
70,001— 75,000											2	2	1	1	5	2	1	1	65	1
75,001— 80,000																				
80,001— 85,000																				
85,001— 90,000																				
90,001— 95,000	1	3	3	5	5	5	3	3.5	167	4										
95,001—100,000											4	4	5	7	7	7	5	5	123	5

who spend 65,000 minutes and achieve seventh place while similar children spend not to exceed 55,000 minutes and achieve second place, and still other children spend less than 50,000 minutes and rank sixth?

Taking these tables as a basis we can give a definite statement as to how much time it is worth while to spend on arithmetic and expect good results. Inasmuch as the ranking method often gives first place on a very narrow margin, it is better to determine optimal times by the inclusion of the first two ranks. This enables us to give a minimum and a maximum for each grade. Following this method we can make Table XLIX.

TABLE XLIX

OPTIMAL TIME TO BE DEVOTED TO STUDY OF ARITHMETIC FROM BEGINNING TO END OF SEVERAL GRADES AS DETERMINED BY RANKS 1 TO 2 OF REPORTED SCHOOLS.

Grade	Minimum Time in Minutes	Maximum Time in Minutes
Fifth	30,000	45,000
Sixth	40,000	55,000
Seventh	45,000	60,000
Eighth	50,000	75,000

Tables L and LI dealing with variabilities show essentially the same thing as do the tables of medians, namely, that excellence in the fundamentals of arithmetic as measured by these tests is not a necessary correlative of long time spent on the subject. It more often accompanies a time shorter than the maximum used by some schools. We could, as in the case of the medians, make a table showing optimal time for each grade. It would be essentially the same table excepting a slight reduction in the seventh grade maximum. We may say, therefore, that Table XLIX represents the optimal time for the study of arithmetic as shown both by the median scores and per cent of variability.

If one turns to the dependability the results are not particularly different. One variation in grade 6 shows the pupils spending maximum time to be second. The margin of superiority is so slight, however, as to be negligible. Tables LII and LIII therefore confirm the figures of Table XLIX.

What now is the meaning of these optimal times? It is clearly this: under some conditions it is possible to do a good quality of work in the fundamentals of arithmetic within the limits of time set in this table for the several grades. It means also that in case a school with a lower score and using less time desires to improve its work it can probably do so by increasing the amount of time devoted to the subject. It means further that in the case of a school which takes longer time without achieving higher rank something is wrong with the school regime. Either the children are deficient in ability due to ancestry or environmental conditions, or the methods of school work are faulty and need to be changed. Doubtless the latter is the fact in many cases.

What changes should be made are, to be sure, not indicated. It is something to have discovered, however, that there is a limit to the amount of deficient results that can be charged to the lack of time. The "crowded program" will not excuse bad results except when the time for a given subject is reduced below a certain minimum. It is worth much that we are discovering in the use of standard tests a means of determining what that minimum should be. Once we have determined what is the optimal time for a given subject, it is incumbent upon a teacher or superintendent to justify his use of more time or his failure to get normal results within the time specified. In either case he is wasting not only public funds but also the time of children.

Objection may be taken that the time reported covers different things in the case of different cities. Thus in one city much time may be given to partial payments, cube root, etc., while in another city the time is given more exclusively to fundamental processes. The children from a school giving a small amount of time may thus do better in this particular test than the pupils giving more time, whereas if we could give a reasoning test the results might be reversed. Such objection is valid, but two things may be said in reply. First, to what extent can you justify the dissipation of a pupil's time over a larger range of arithmetical subjects with the consequent danger of achieving low ability in the fundamentals? Second, these figures must be regarded as tentative and subject to alteration by subsequently collected data. Until thus corrected, however, they should stand as the best authenticated standard to date.

Two methods of supplementing these data suggest themselves First, we should have similar data from many other school sys-

tems. Second, a careful teacher or group of teachers could keep accurate data on the entire school time devoted to arithmetic in case of a particular school group. Accurate data in terms of minutes per day devoted to any and every arithmetical process should be kept and the progress of the children should be measured from time to time.

The data derived from one of these methods would serve as a check on the data gained by the other. By the use of both we should be able to determine with a high degree of assurance what the optimal time for every part of the work should be.

TABLE L

TIME SPENT: VARIABILITIES

NUMBER OF MINUTES	Grade 5									Grade 6								
	Addition		Subtraction		Multiplication		Division		Total No. of Pupils	Addition		Subtraction		Multiplication		Division		Total No. of Pupils
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights		Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	
0— 25,000	29	66	25	59	28	79	45	80	302									
25,001— 30,000	29	54	25	41	25	54	43	85	1,530									
30,001— 35,000	27	58	24	41	29	37	42	76	388	19	55	24	39	30	49	33	65	648
35,001— 40,000	23	50	27	39	25	52	38	71	102	34	52	12	38	28	44	39	59	1,144
40,001— 45,000	29	53	26	44	29	48	41	90	91	26	53	20	28	25	43	43	59	348
45,001— 50,000										25	44	17	29	25	46	41	63	97
50,001— 55,000										24	49	20	30	24	40	35	47	84
55,001— 60,000																		
60,001— 65,000	24	55	22	42	31	60	38	81	211									
65,001— 70,000																		
70,001— 75,000																		
75,001— 80,000																		
80,001— 85,000										25	53	24	38	30	42	44	67	209
85,001— 90,000																		
90,001— 95,000																		
95,001—100,000																		

TABLE L—Continued

TIME SPENT: VARIABILITIES

NUMBER OF MINUTES	Grade 7									Grade 8								
	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights		Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights	
0— 25,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
25,001— 30,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
30,001— 35,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
35,001— 40,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
40,001— 45,000	27	48	21	32	24	42	34	44	493	....	....	....	....	....	....	....	....	....
45,001— 50,000	25	44	22	28	24	37	31	36	544	30	45	22	32	23	38	29	38	104
50,001— 55,000	24	50	21	33	28	46	37	53	470	24	44	23	33	24	35	32	57	298
55,001— 60,000	27	43	21	33	28	43	36	50	237	23	35	20	27	23	30	30	34	469
60,001— 65,000	....	....	....	....	....	....	....	....	....	24	46	24	30	25	30	32	44	486
65,001— 70,000	....	....	....	....	....	....	....	....	....	26	37	25	28	28	35	31	37	101
70,001— 75,000	....	....	....	....	....	....	....	....	....	21	38	21	27	26	32	26	40	65
75,001— 80,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
80,001— 85,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
85,001— 90,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
90,001— 95,000	29	50	22	38	29	37	37	52	167	....	....	....	....	....	....	....	....	....
95,001—100,000	....	....	....	....	....	....	....	....	....	25	43	24	30	30	41	33	41	123

TABLE LI

TIME SPENT: RANK IN VARIABILITIES

NUMBER OF MINUTES	Grade 5										Grade 6									
	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Final Rank	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Final Rank
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights			Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights		
0— 25,000.	5	6	3.5	6	3	6	6	3	302	6	....	....	....	....	....	....	....	....	....	....
25,001— 30,000.	5	3	3.5	2.5	1.5	4	5	5	1,530	4	....	....	....	....	....	....	....	....	....	....
30,001— 35,000.	3	5	2	2.5	4.5	1	4	2	388	2	1	6	5.5	6	5.5	6	1	5	648	6
35,001— 40,000.	1	1	6	1	1.5	3	1.5	1	102	1	6	3	1	4.5	4	4	3	2.5	1,144	4
40,001— 45,000.	5	2	5	5	4.5	2	3	6	91	5	5	4.5	3.5	1	2.5	3	5	2.5	348	3
45,001— 50,000.	....	....	....	....	....	....	....	....	....	....	3.5	1	2	2	2.5	5	4	4	97	2
50,001— 55,000.	....	....	....	....	....	....	....	....	....	....	2	2	3.5	3	1	1	2	1	84	1
55,001— 60,000.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
60,001— 65,000.	2	4	1	4	6	5	1.5	4	211	3	....	....	....	....	....	....	....	....	....	....
65,001— 70,000.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
70,001— 75,000.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
75,001— 80,000.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
80,001— 85,000.	....	....	....	....	....	....	....	....	....	....	3.5	4.5	5.5	4.5	5.5	2	6	6	209	5
85,001— 90,000.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
90,001— 95,000.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
95,001—100,000.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

TABLE LI—Continued

TIME SPENT: RANK IN VARIABILITIES

NUMBER OF MINUTES	Grade 7										Grade 8									
	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Final Rank	Addition		Sub-traction		Multipli-cation		Division		Total No. of Pupils	Final Rank
	Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights			Attempts	Rights	Attempts	Rights	Attempts	Rights	Attempts	Rights		
0— 25,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
25,001— 30,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
30,001— 35,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
35,001— 40,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
40,001— 45,000	3.5	3	2	1	1.5	3	2	2	493	2	....	....	....	....	....	....	....	....	....	....
45,001— 50,000	2	2	4.5	2	1.5	1.5	1	1	544	1	7	6	3	6	1.5	6	2	3	104	4
50,001— 55,000	1	4.5	2	3.5	3.5	5	4.5	5	470	4	3.5	5	4	7	3	4	5.5	7	298	5
55,001— 60,000	3.5	1	2	3.5	3.5	4	3	3	237	3	2	1	1	1.5	1.5	1	3	1	469	1
60,001— 65,000	....	....	....	....	....	....	....	....	....	....	3.5	7	5.5	4.5	4	4	5.1	6	486	6
65,001— 70,000	....	....	....	....	....	....	....	....	....	....	6	2	7	3	6	4	4	2	101	3
70,001— 75,000	....	....	....	....	....	....	....	....	....	....	1	3	2	1.5	5	2	1	4	65	2
75,001— 80,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
80,001— 85,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
85,001— 90,000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
90,001— 95,000	5	4.5	4.5	5	5	1.5	4.5	1.5	167	5	....	....	....	....	....	....	....	....	....	....
95,001—100,000	....	....	....	....	....	....	....	....	....	....	5	4	5.5	4.5	7	7	7	5	123	7

TABLE LII

Time Spent: Per Cent of Dependability

Number of Minutes	Grade 5				Grade 6				Grade 7				Grade 8			
	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division	Addition	Subtraction	Multiplication	Division
0— 25,000	.44	.57	.53	.47												
25,001— 30,000	.56	.69	.61	.59												
30,001— 35,000	.55	.73	.67	.64	.57	.64	.64	.71								
35,001— 40,000	.58	.71	.64	.69	.64	.72	.69	.73								
40,001— 45,000	.69	.82	.72	.75	.58	.82	.62	.76	.57	.76	.62	.82				
45,001— 50,000					.60	.65	.68	.82	.66	.84	.68	.83	.60	.76	.69	.81
50,001— 55,000					.65	.80	.72	.91	.57	.75	.64	.78	.60	.77	.72	.81
55,001— 60,000									.65	.75	.69	.83	.68	.82	.67	.94
60,001— 65,000	.54	.64	.54	.56									.62	.78	.67	.84
65,001— 70,000													.70	.99	.70	.86
70,001— 75,000													.64	.84	.78	.86
75,001— 80,000																
80,001— 85,000					.58	.74	.70	.75								
85,001— 90,000																
90,001— 95,000									.56	.70	.56	.81				
95,001—100,000													.65	.74	.69	.85

TABLE LIII

TIME SPENT: RANK IN DEPENDABILITY

NUMBER OF MINUTES	Grade 5					Grade 6					Grade 7					Grade 8				
	Addition	Subtraction	Multiplication	Division	Ranking for All Tests	Addition	Subtraction	Multiplication	Division	Ranking in All Tests	Addition	Subtraction	Multiplication	Division	Ranking in All Tests	Addition	Subtraction	Multiplication	Division	Ranking in All Tests
0— 25,000	6	6	6	6	6															
25,001— 30,000	3	4	4	4	4															
30,001— 35,000	4	2	2	3	3	6	6	5	6	6										
35,001— 40,000	2	3	3	2	2	2	4	3	5	3½										
40,001— 45,000	1	1	1	1	1	4½	1	6	3	5	3½	2	4	3	3					
45,001— 50,000						3	5	4	2	3½	1	1	2	1½	1	6½	6	4½	6½	7
50,001— 55,000						1	2	1	1	1	3½	3½	3	5	4	6½	5	2	6½	5
55,001— 60,000											2	3½	1	1½	2	2	3	6½	1	3
60,001— 65,000	5	5	5	5	5											5	4	6½	5	6
65,001— 70,000																1	1	3	2½	1
70,001— 75,000																4	2	1	2½	2
75,001— 80,000																				
80,001— 85,000						4½	3	2	4	2										
85,001— 90,000																				
90,001— 95,000											5	5	5	4	5					
95,001—100,000																3	7	4½	4	4

INDIANA STANDARD CHART

In Figure 49 is presented a chart that should prove of great value as an administrative device. In this figure the individual medians of the 8,712 children reported by the twenty cities are represented by short horizontal lines across the page so drawn as to appear at mid-section of the vertical dimension. These lines are called the Indiana Standards. Each vertical line represents the scale for the test in question. The first, third, fifth, etc., lines represent the number of problems attempted in the several tests in the several grades. The second, fourth, sixth, etc., lines in a corresponding manner scale the examples right. The portion of each line below the Indiana Standard is proportional to the difference between the zero and the median score. It is accordingly scaled into the proportional number of parts. The part of the line above the Indiana Standard is similarly scaled. Each vertical line is therefore a different scale from every other vertical line, since the median is different in every case.

It is possible on this form to graph the results from any class, school, or city and to see quickly its relative standing. To do this you locate the proper score on its appropriate vertical line. If you join the points so located on the attempts scale by a solid line with the similar point on the rights scale, you have represented the dependability of the work. If the line so drawn is parallel to the Indiana Standard the per cent of dependability is the same as the Indiana Standard. If the line slants upward to the right, the dependability is greater, If the line slants downward to the right, the dependability is less.

Figures 50 and 51 show the results for two cities which are not represented in previous figures. The results from Anderson appear in the table but were not received in time to be included in the data from which the first graphs were made. The Bloomington returns do not appear in the tables. They are given here for their intrinsic interest. Both of these cities appear clearly above the Indiana Standard although each falls short in a few instances. This superiority is true also of their ranks in dependability as is shown by the general upward slant of the dependability lines.

The causes for this evident superiority are not certain, but from the writer's somewhat intimate knowledge of the situation in both of these cities he is willing to hazard a guess. In the latter case the Courtis tests have been used at frequent intervals during the past three or four years. As a result the teachers have become

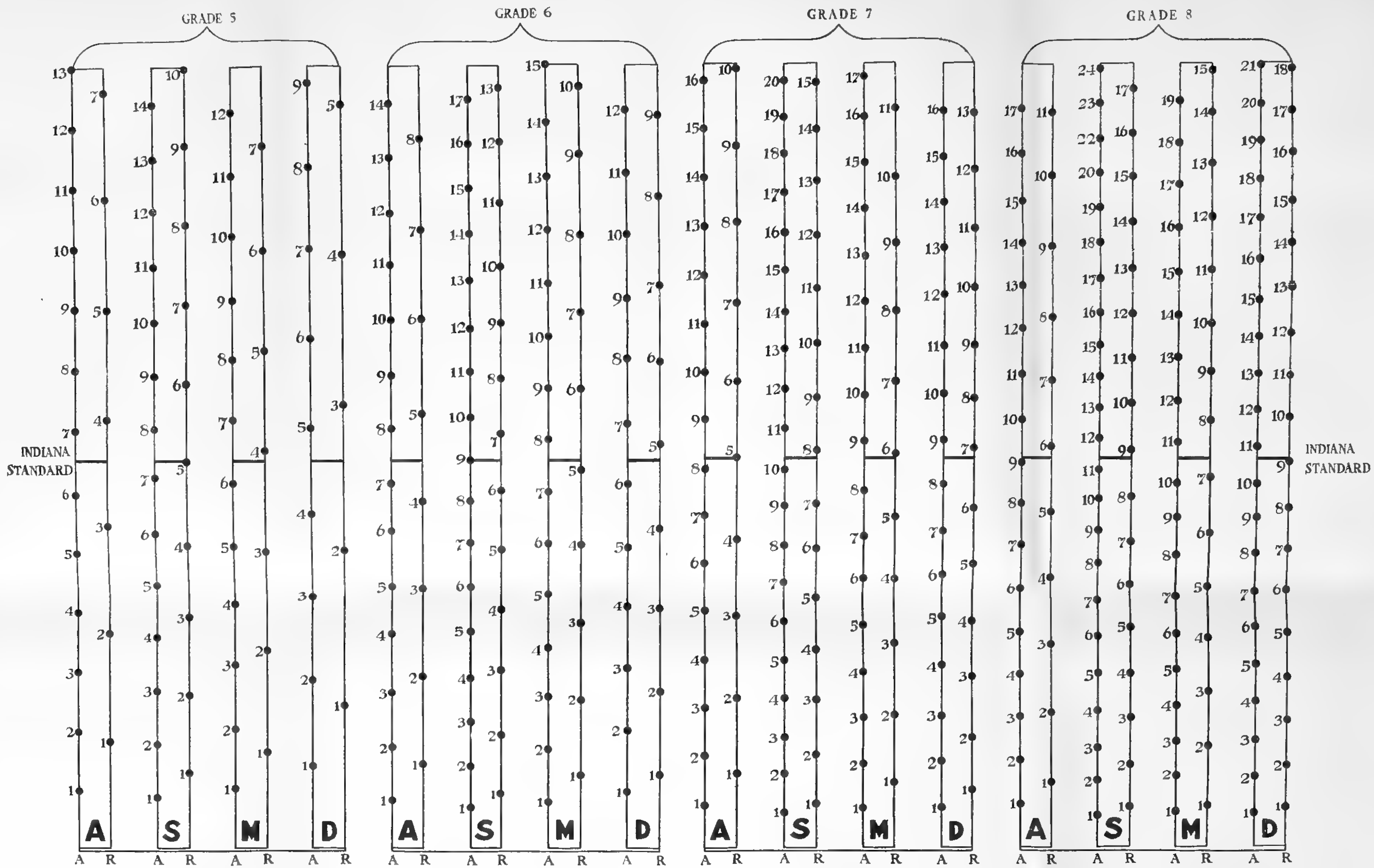

FIG. 49 INDIANA STANDARD MEDIANS AND DEPENDABILITY

familiar with the idea of standards and with the Courtis Standards in particular. There has been an effort on the part of both teachers and superintendent to bring the children up to the standard of ability set by Mr. Courtis. In the case of Anderson the Courtis tests had not previously been used. For a number of years, however, there has been very close supervision of the arithmetic work throughout the grades. This supervision has aimed among other things to bring each class up to a definite stage of progress month by month. It has inevitably, therefore, set standards which, while not as objective as the Courtis standards, have yet had more objective value than the aim of an individual teacher or even of a single school building. Such a standard has, at least, city-wide value, and when impressed on the teachers by frequent teachers' meetings becomes a very definite objective aim toward which to work.

Thus in both Anderson and Bloomington there have been present in the minds both of teachers and supervisory force very definite aims to be accomplished by the work in arithmetic. It is just possible that the presence of such a definite aim is the determining thing in bringing each city up to its high score. If so, it is an interesting statistical measure of the value of an ideal. This interpretation agrees with the finding of Dr. J. M. Rice in his study of the causes of success and failure in arithmetic.

It may be objected that the presence of a definite aim is only one of a number of causes which operate. Thus it may be pointed out that in Bloomington the teachers have more than average academic training, two years of college work being required. In Anderson the teachers are not only given definite aims to be accomplished but also detailed methods to use in reaching these aims. Anderson begins work in the second school year; Bloomington in the third; both give the optimal time to the subject. It would be foolish to deny all value to other causes, but detailed investigation would probably show that they are not the determining things, both good and bad scores occurring in a somewhat chaotic manner under the same conditions. It may be expected, on the other hand, that the presence or absence of a definite ideal to be accomplished in the fundamentals of arithmetic is *determinative* in character. Scores will be low as aims are general and vague or high when ideals are specific and clearcut.

The opportunity offers for some school to make the crucial experiment. If in a school system there has been little supervision and each teacher has been allowed to set her own aims and reach

them or not as she finds it possible, the experiment can be made by giving the standard test, determining the present standing of the group setting a definite aim to be achieved, and three months later measuring again for results. The chances are very great that there will be a decided change in the direction of the standard score. If the experiment is to be valid the other conditions must, of course, remain the same. Another way to get at the problem would be to measure a very large number of school cities and make a definite study of the degree to which such definite aims were present in the schools making different scores.

CONCLUSION

In conclusion it seems worth while to point the moral of this study. It is not that we have discovered some facts about teaching arithmetic, however important these facts may be. This work can be regarded only as preliminary. The really important problems are yet to be attacked. The significant thing is that we have found a way to work. Lord Kelvin noted that the great advance in physics came when physicists began to invent instruments of measurement and to make quantitative studies. There is hope that the standardized test will do for education what the footrule, the thermometer, the chemist's balance, and other instruments have done for physical science. Every intelligent use of a standardized scale is a step toward a science of education. It is a thing of note that so many school systems should have taken this step.

Not less important than the discovery and acceptance of the standardized scale is the plan of coöperation. The University would have experienced some difficulty in collecting a body of data as important and reliable as that here reported. The school superintendents and teaching corps did it in the course of their work. It had immediate value to them and their children. On the other hand, any school superintendent or group of school superintendents would have found it difficult to make the comparative studies. It has taken hundreds of hours of work of trained students and helpers and has cost the University a considerable amount of money to get the material into print. Whatever virtue the study may have is, then, the result of the coöperative endeavor of the school officers on the one hand and of the University on the other. This plan of educational investigation has large possibilities of future usefulness for the State of Indiana.

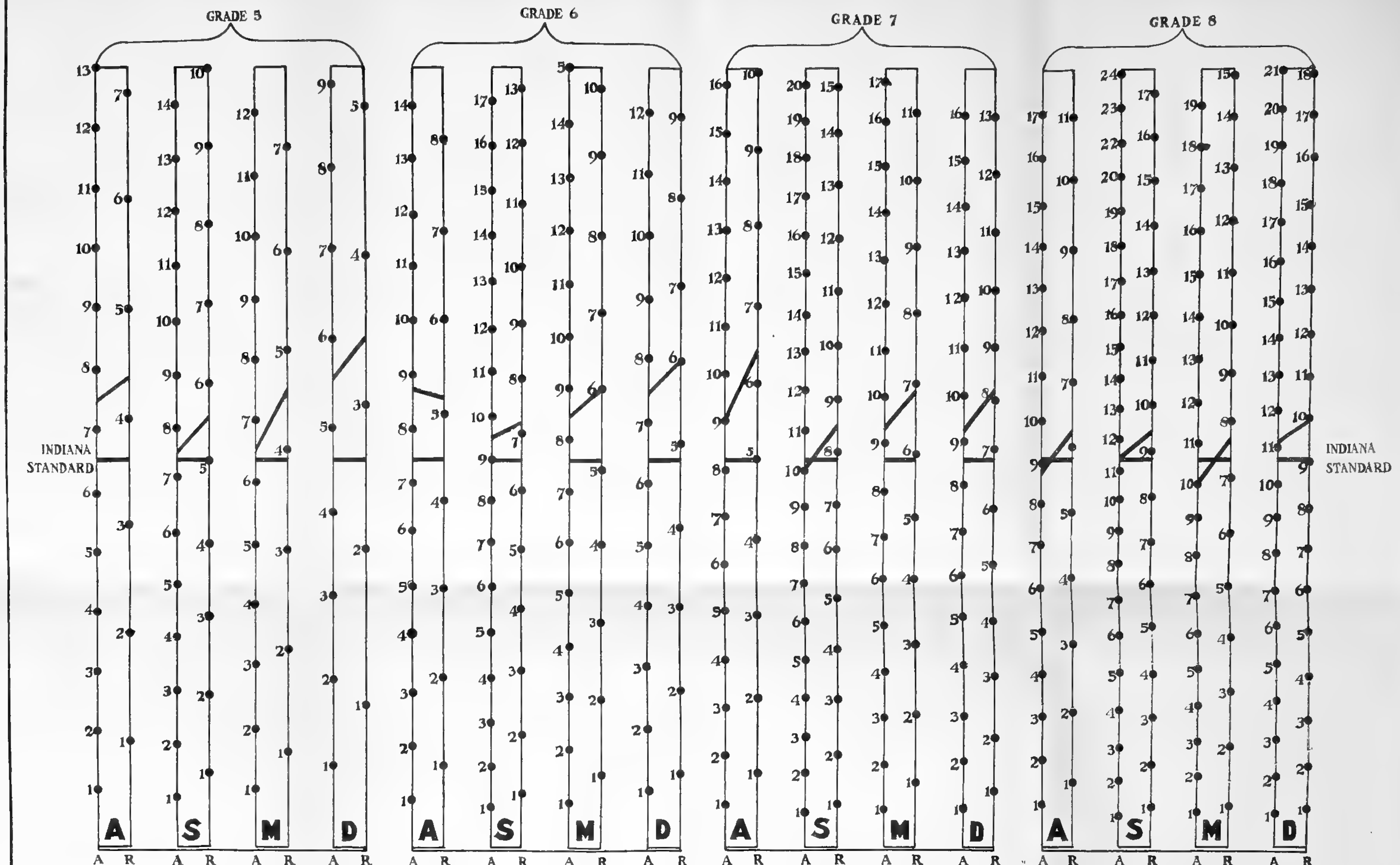

FIG. 50 ANDERSON MEDIANS AND DEPENDABILITY

Bibliography

Courtis, S. A. First Annual Accounting. Bulletin Number One, Detroit, 1912.

Courtis, S. A. Second Annual Accounting. Bulletin Number Two, Detroit, 1913.

Courtis, S. A. Better Teaching in Arithmetic. Detroit, 1913.

Courtis, S. A. Median Scores, Series B. Bulletin Number Three, Detroit, 1914.

Kelly, F. J. Teachers' Marks. Columbia University Contributions to Education, 1914.

Rice, J. M. Scientific Management in Education. New York, 1913.

Stone, Cliff Winfield. Arithmetical Abilities and Some Factors Determining Them. New York, 1908.

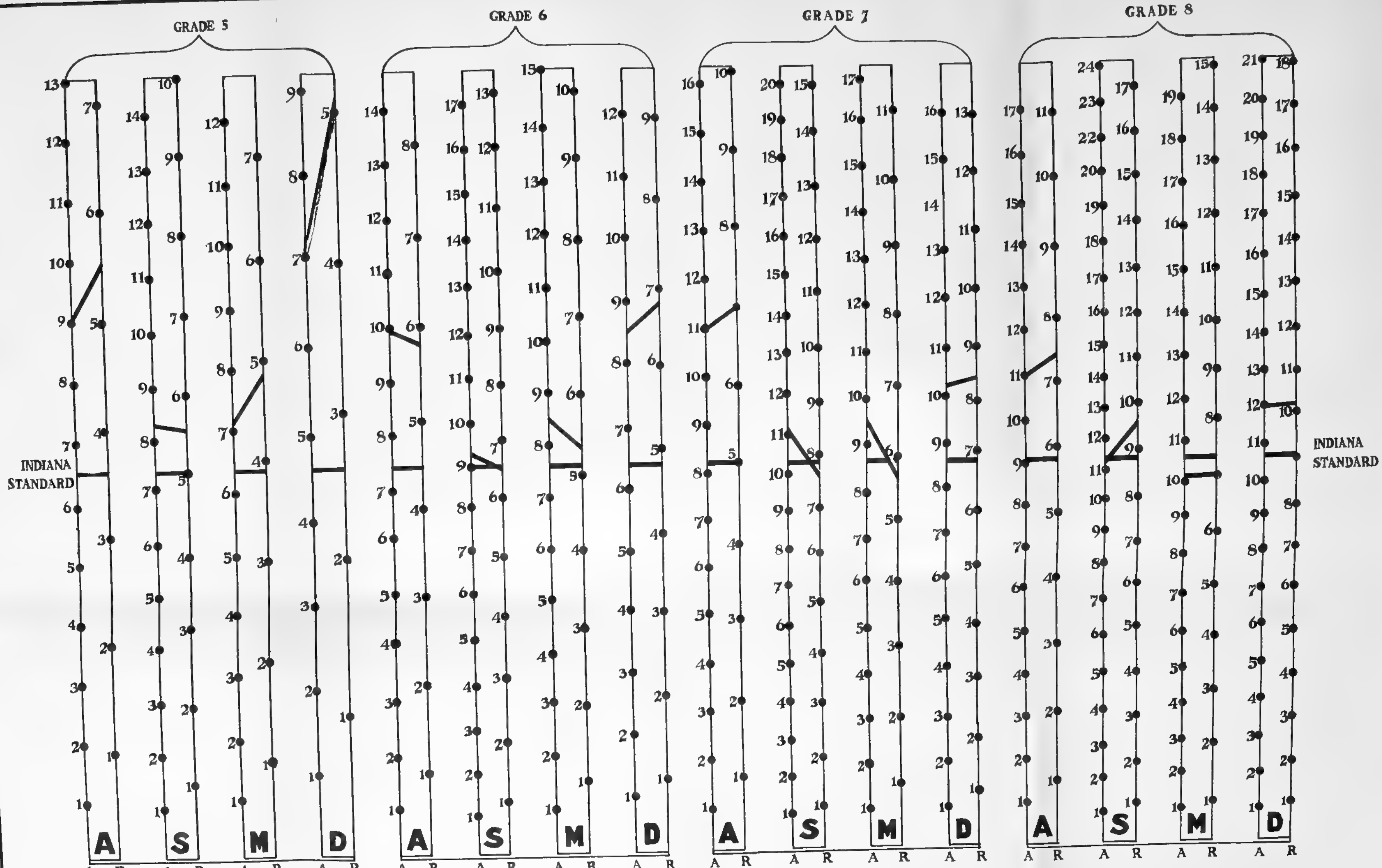

FIG. 51 BLOOMINGTON MEDIANS AND DEPENDABILITY